

Poly-88

Advertisements

POLY 88 SYSTEM PRICES

Part No.	Price	Description
002200	\$ 595.	System 1 kit includes 8080 vectored interrupt processor board with real time clock, 1/2K of RAM, and 1K monitor on ROM; Video Terminal Interface for 16 line by 32 character display on video screen and keyboard input port; cabinet, backplane and power supply; complete assembly, theory, and operation manual.
002210	690.	System 2 kit includes all items in System 1, with a 64 character line display and a cassette interface kit.
002220	990.	System 3 kit includes System 2 plus 8K of RAM with BASIC and assembler programs on cassette tape.*
002230	1350.	System 4 is the complete kit. It includes System 3 with TV monitor, keyboard, and cassette recorder with all necessary cables and connectors.
001230	1750.	System 7 is System 4 assembled, tested, and ready to run.
101017	15.	Poly 88 System manual

Options Available Separately

002080	45.	Serial port (RS-232 or current loop) for Systems 2, 3, or 4; kit.
001080	60.	Assembled serial port for System 7.
800001	15.	Assembler on cassette.*
800051	15.	BASIC on cassette.*

PolyMorphic/Altair Compatible Options

002030	300.	8K RAM board with static memory and provision for battery backup. Kit.
002026	210.	Video Terminal Interface, 64 character line. Kit.
002010	145.	Analog Interface, 1 channel kit.
002040	55.	POLY I/O prototype board kit.

Delivery 30 days. Complete price list available on request. Prices subject to change without notice.

* Basic on cassette tape will be released December 15, 1976.

* 8080 Assembler on cassette tape will be released by December 1, 1976.

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Building Blocks

Looking for a solid but low-cost foundation for your custom and limited-run systems? A versatile microcomputer system for standardized development? System 88 offers a complete and compatible product line...capable of expanding to meet your clients' growing needs. The 8810, with one mini-floppy (90kb), serves as a "solution box" or as an inexpensive component in a satellite system. The 8813 is a development tool, a print-out and copy station for fleet or "stand alone" use. With two 88/MS units, total storage capacity exceeds 5 Mb. A variety of systems, all under \$10,000.

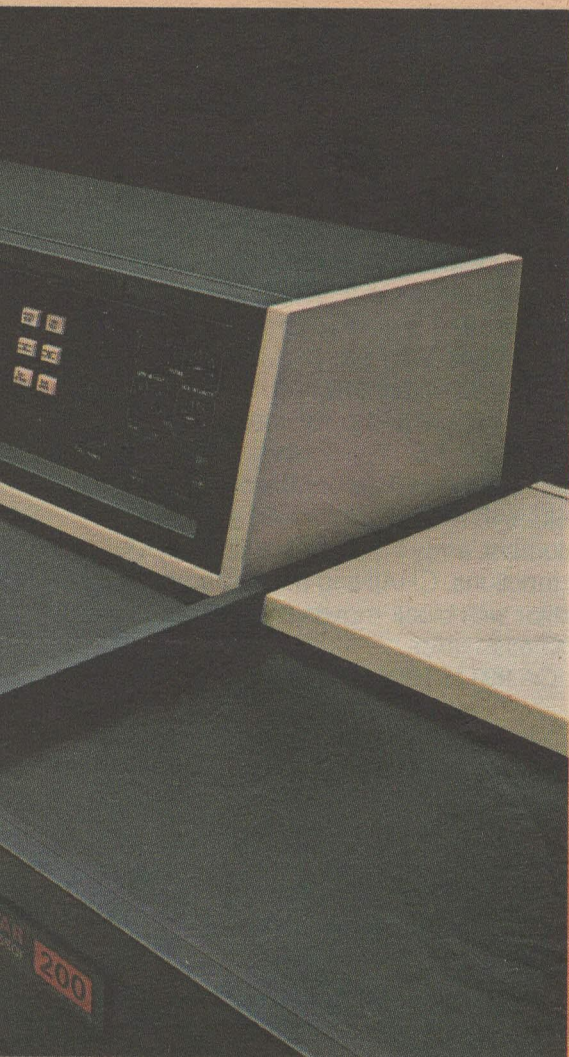
HARDWARE Memory-mapped video with graphics ■ upper and lower case keyboard with cursor keys ■ vectored interrupt and real-time-clock ■ 5" mini-floppies or 8" dual-sided, double-density floppies ■ integral serial port ■ wood cabinet or rack-mountable.

SOFTWARE Full-feature DOS ■ extended BASIC with multi-dimensioned string and numeric arrays, 8 or 14 digit precision, MAT statement, array functions like SUM, MAX, MEAN, output formatting, numerous scientific functions, CHAINing of programs, cross-reference or dumps of variables ■ text editor with block moves and deletes, cursor control, file merging ■ disk-to-disk macro-assembler.

Contact us at 460 Ward Drive, Santa Barbara, CA 93111 (805) 967-0468

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The Kodak laser printer prints at the rate of more than $2\frac{1}{2}$ computer pages per second.

So it can zap out a 150-page report in a shade under one minute. Or a 1000-page report in about 6 minutes.

Because it prints on microfilm—not paper—the Kodak printer condenses up to 270 bulky computer pages on a single 105 x 148-mm fiche. And it does it in under 2 minutes.

That means a Kodak printer can print a 1000-page report at a reduction ratio of 48:1 on just 4 microfiche. And each fiche is produced, titled, and indexed, ready for fast retrieval.

How does paper stack up against fiche? Using current prices,* 1000 pages of computer paper would cost \$3.50, while 4 fiche would cost just 54¢. So compared with paper, not only is printing on film demonstrably faster, it's also thousands of dollars a month cheaper.

Why not call your Kodak representative today for a demonstration of the Kodak

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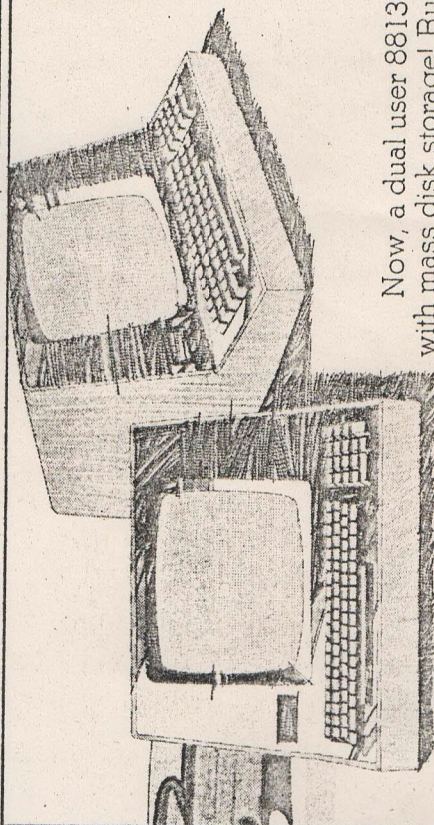
Eastman Kodak Company,
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**Kodak Komstar microimage processors.
The printers that print without paper.**

Instead of more exotic ways of performing mathematics, envision a branch of calculator evolution turning toward amplifying individuals in their profession via people amplifier devices or appliances. That is, consider identifying a small number of primitive functions — four, for example — unique to management that can be cast in hardware which is programmable (by a button and later via voice) like a microprocessor.

Additionally, breakthroughs



Now, a dual user 8813
with mass disk storage! Run

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two programs at once. One person can update inventory while another does word processing. It's like having another system at only a fraction of the original cost.

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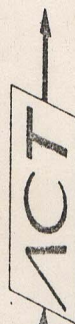
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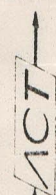
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The Computer for the Professional

The 8813 was built with you, the professional, in mind. It quickly and easily processes cost estimates, payrolls, accounts, inventory, patient/client records and much more. You can write reports, briefs, and proposals on the 8813's typewriter keyboard, see them on the video screen, and instantly correct, revise, or print them.

Using the 8813, one person can process what would normally require many secretaries, several bookkeepers, and a great deal of *time*. And data storage takes a small fraction of the *space* used by previous methods.

You don't need to learn complicated computer languages. The 8813 understands commands in English. If you want to write your own programs, the 8813 includes a simple computer language, BASIC, that you can master in a few days. The 8813 slashes the professional's overhead. It's a powerful time and money-saving ally. Prices for complete systems including printer start at less than \$8,000.

See the 8813 at your local dealer or contact PolyMorphic Systems, 460 Ward Drive, Santa Barbara, California, 93111, (805) 967-0468, for the name of the dealer nearest you.

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Apple speaks three languages: fast integer BASIC, floating point BASIC for scientific and financial applications, and 6502 assembly language. That's maximum programming flexibility. And, to preserve user's space, both integer BASIC and monitor are permanently stored in 8K bytes of ROM, so you have an easy-to-use, universal language instantly available. BASIC gives you graphic commands: COLOR=, VLIN, HLIN, PLOT and SCRN. And direct memory access, with PEEK, POKE and CALL commands.

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There's a growing selection of pre-programmed software from the Apple Software Bank — Basic Finance, Checkbook, High Resolution Graphics and more. Now there's a User Section in our bank, to make it easy for you to obtain programs developed

Which personal computer will be most enjoyable and rewarding for you? Since we delivered our first Apple® II in April, 1977, more people have chosen our computer than all other personal computers combined. Here are the reasons Apple has become such an overwhelming favorite.

Apple is a fully tested and assembled mainframe computer. You won't need to spend weeks and months in assembly. Just take an Apple home, plug it in, hook up your color TV* and any cassette tape deck — and the fun begins.

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Apple is so powerful and easy to use that you'll find dozens of applications. There are Apples in major universities, helping teach computer skills. There are Apples in the office, where they're being programmed to control inventories, chart stocks and balance the books. And there are Apples at home, where they can help manage the family budget, control your home's environment, teach arithmetic and foreign languages and, of course, enable you to create hundreds of sound and action video games.

When you buy an Apple II you're investing in the leading edge of technology. Apple was the first computer to come with BASIC in ROM, for example. And the first computer with up to 48K bytes RAM on one board, using advanced, high density 16K devices. We're working to keep Apple the most up-to-date personal computer money can buy. Apple II delivers the features you need to enjoy the real





The Computer for the Professional

Whether you are a manager, scientist, educator, lawyer, accountant or medical professional, the System 8813 will make you more productive in your profession. It can keep track of your receivables, project future sales, evaluate investment opportunities, or collect data in the laboratory.

Use the System 8813 to develop reports, analyze and store lists and schedules, or to teach others about computers. It is easily used by novices and experts alike.

Reliable hardware and sophisticated software make this system a useful tool. Several software packages are included with the machine: an advanced disk operating system supporting a powerful BASIC language interpreter, easy to use text editor, assembler and other system utilities. Prices for complete systems start at \$3250.

See it at your local computer store or contact us at 460 Ward Dr., Santa Barbara, CA 93111, (805) 967-0468.

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Built and backed by Pertec Computer Corporation, (world's leading independent producer of computer peripheral equipment and distributed processing and data entry systems).

Now you can gain all the speed and flexibility of a disk-based PolyMorphic microcomputer system without scrapping your POLY 88.

Our POLY 88 Upgrade-to-Disk Kit enables you to quickly and easily convert your POLY 88 into a complete System 8813, a very versatile disk system with one, two or three floppy disk drives.

You retain all the essential parts of your POLY 88 system (including the powerful BASIC software library) and gain the increased access speed and programming flexibility of PolyMorphic's remarkable new System 8813.

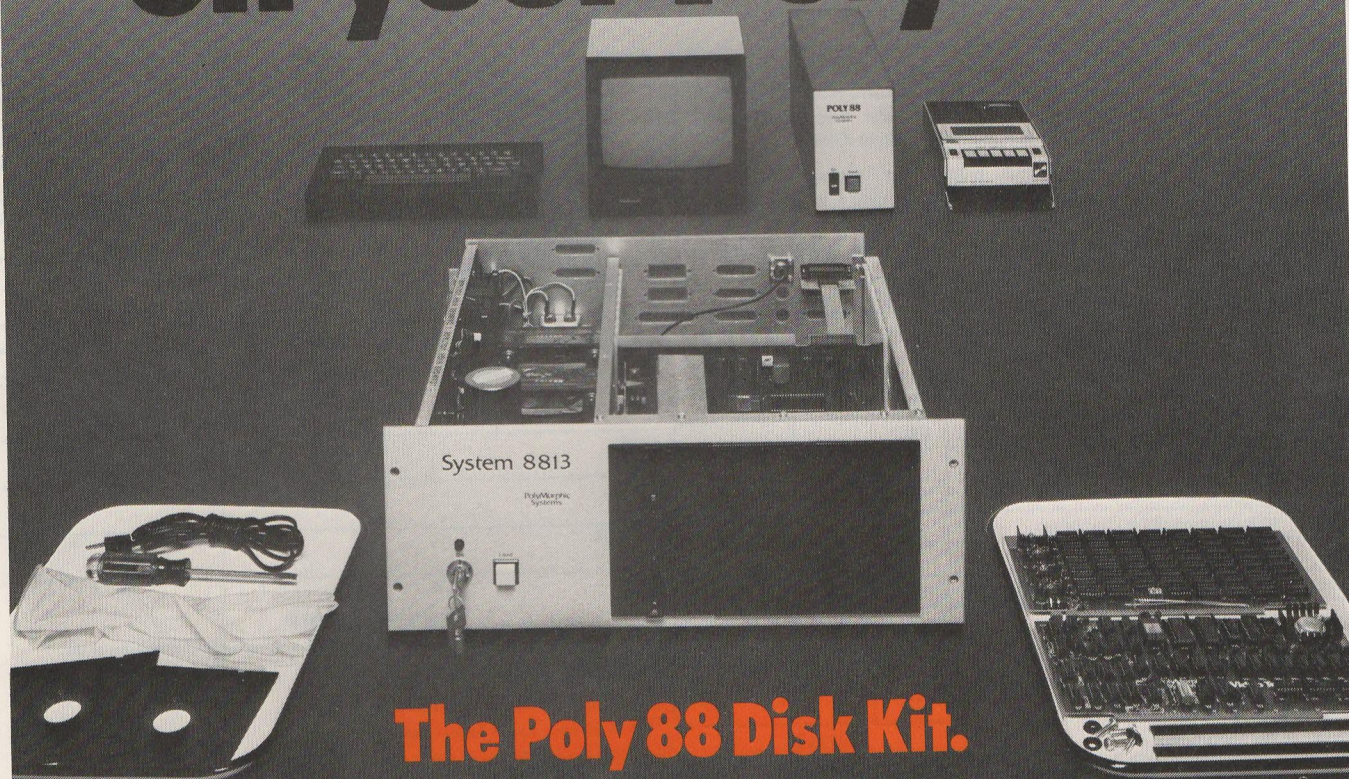
Our POLY 88 Upgrade-to-Disk Kit contains everything you need to perform a quick "disk transplant" on your POLY 88 at home, using a few simple tools. Each upgrade kit contains a brushed aluminum

front panel and walnut cabinet with one, two or three floppy disk drives, controller, power supply, fan and 2K of ROM. You also receive two copies of our system disk, containing our powerful disk operating system, fully extended BASIC and versatile text editor and assembler. The single-drive POLY 88 Upgrade-to-Disk Kit costs \$1,450.

Why wait? Drop by your nearest PolyMorphic Systems dealer today and have him demonstrate the speedy and flexible new System 8813 for you. Then, ask him to show you just how quickly and easily you can perform a disk transplant on your POLY 88.

If you can't drop by your dealer, please call us at (805) 967-0468. Or write PolyMorphic Systems Inc., 460 Ward Drive, Santa Barbara, CA 93111.

Perform a disk transplant on your Poly 88.

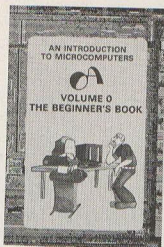


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Many books on microprocessors and their use are now on the market, and most of them have names that sound alike. But Osborne & Associates' books have dominated this market since 1975, when our first book appeared. With rave reviews from all over the world, with more than three hundred university text adoptions, our books are all best sellers. In fact, "An Introduction To Microcomputers: Volume I — Basic Concepts" now holds the world's record in sales volume for any computer textbook sold for a profit.

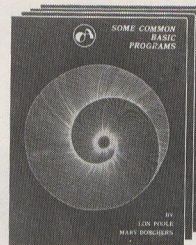
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This is the book for the absolute beginner. Assuming that you know nothing about computers, math or science of any kind, this book explains what computers are all about — and it takes you to the point where you can read Volume I. 300 pages.

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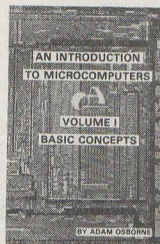
For the microcomputer user, a series of books provide complete programs, written in BASIC. All these books are by Lon Poole and Mary Borchers.

"Some Common Basic Programs" 200 pages.
Book No: 21002 \$7.50

"Payroll With Cost Accounting — In Basic", 400 pages
Book No.: 22002 \$12.50

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Book No.: 23002 \$12.50 Available early 1978

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Book No.: 24002 \$12.50 Available mid 1978



"An Introduction To Microcomputers: Volume I — Basic Concepts" By Adam Osborne.

The world's best selling computer textbook. This book explains, clearly, concepts common to all microcomputers, yet specific to none. 350 pages.

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8080A/8085

ASSEMBLY LANGUAGE PROGRAMMING

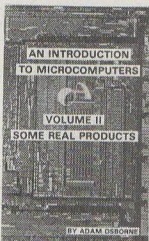


Lance Leventhal

"8080A and 8085 Assembly Language Programming" By Lance Leventhal.

This book is for the assembly language programmer or student; it explains assembly language programming for the 8080A and 8085 microcomputers. The book contains numerous examples. 400 pages.

Book No.: 31003 \$7.50



"An Introduction To Microcomputers: Volume II — Some Real Products" (Revised June 1977) By Adam Osborne, Susanna Jacobson and Jerry Kane.

This book describes every common microprocessor and all of their support devices. Information is new and clearly written. Only data sheets are copied from manufacturers. 1200 pages.

Book No.: 3001 \$15.00



The "Programming For Logic Design" series of books show how to use microprocessors in a digital logic environment.

"8080 Programming For Logic Design" By Adam Osborne. 300 pages. Book No.: 4001 \$7.50

"6800 Programming For Logic Design" By Adam Osborne. 300 pages. Book No.: 5001 \$7.50

"Z80 Programming For Logic Design" By Adam Osborne, Susanna Jacobson and Jerry Kane.
Book No: 7001 \$7.50

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F1

Introducing Our Disk System.



It's like adding a room to your brain!

The System 8813 from PolyMorphic Systems is a complete, powerful problem solver in a single walnut cabinet. This machine allows you to perform complex financial, engineering, and scientific models in the comfort of your office or den.

The high speed video display presents your results in text, tables and graphics. The detachable typewriter-like keyboard permits relaxed program entry and operation. Convenient mini-discs store programs and data for compact filing, secure storage, and fast access. Our disc BASIC programming language is simple enough for the computer newcomer, yet powerful enough to amaze the most advanced users.

The whole family can immediately use and enjoy pre-programmed applications and educational packages. Let the System 8813 become your trusted business, profession, and

personal tool. The PolyMorphic Disc System is a completely assembled and tested unit with brushed aluminum front panel, walnut cover, detachable keyboard, video monitor, 16K RAM. Includes system software and fully extended BASIC on disc.

System with 1 disc drive	— \$3250
System with 2 disc drives	— 3840
System with 3 disc drives	— 4430

Delivery 60 days ARO. Upgrade packages for POLY 88 owners will also be available. Prices and specifications subject to change without notice.

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with a course entitled "Computer Calculations." The sequence would be offered not only to full-time students at Franklin, but also to anyone in the community who, for either industrial or personal reasons, wanted a solid background in microprocessors. Students would need no previous experience with microprocessors, and the sequence would be offered as an attractive alternative to a 3 day seminar.

With the philosophies and preliminaries taken care of, implementation of the sequence remained. By this time it was late August, and the sequence was scheduled to begin the following January. Being the instructor, I was responsible for putting the entire package together. Two tasks presented themselves: the first was to adopt a course outline and prepare corresponding lectures, and the second was to equip the laboratory.

The first task was relatively easy. The obvious strategy was to start from the absolute basics and work upward. Accordingly, the course would begin with a review of binary numbers and binary operations. A review of digital logic elements, both gates and flip flops, would be next, followed by development of a generalized arithmetic and logic unit. The arithmetic and logic unit would proceed to a generalized microprocessor unit, followed by a discussion of a particular microprocessor. Course development could not proceed until specific laboratory equipment was selected.

One of the problems at this point was selection of a suitable textbook. No general textbooks on microprocessors were available at the time. I chose Blakeslee's *Digital Design with Standard MSI and LSI* because a few of its chapters covered microprocessors and microcomputer system elements. In retrospect, the text was not very good for the sequence because of its constant emphasis on hardware design considerations.

While preparing the lectures, I began the process of acquiring laboratory equipment. At the time, the two manufacturers who seemed to be far ahead of the pack were Intel and Motorola. I thought that these two would be in the best position to donate equipment, considering their stable positions in the marketplace and their competitiveness. Accordingly, I contacted local representatives from both Intel and Motorola. I asked each for any help they could provide, and I reminded each that I was talking to the other.

The Intel representative stated flatly that there was nothing he could do personally, but he advised me of a university donation program. I wrote to Intel in California requesting more information and an application form. The material came shortly there-

after, and it turned out that each application was good for up to four kits, each containing an 8080 chip, 256 words of programmable memory, 1 K of blank erasable read only memory, and four 8212 data latch chips. I made a copy of the application and gave it to another instructor at Franklin. We sent in our applications sometime in September; in mid-November, we received eight kits in the mail. Each kit contained the chips plus one programmer reference card.

The Motorola representative said he didn't know exactly what to do, but he was sure there was something. After much correspondence (among him, me, Austin and Phoenix), he said Motorola would provide five Microcomputer Evaluation Kits, without read only memories, if the University would purchase four kits. Each of these kits contained an M6800, 128 words of programmable memory, two PIAs, one ACIA, a printed circuit board, 1 K of read only memory containing the MIKBUG debugging program, assembly instructions, a reference manual, and an applications manual. This offer came in early December.

It appeared that the cash values of Intel's and Motorola's donations were about equal. Intel's equipment was already in, and I had to decide how to proceed. Whereas Intel's donation represented more raw computing power, Motorola's contribution was a better package, which included a tested system design, software and a Teletype interface. Considering that I would have to do the system design for the Intel package, and considering that I was up to my ears already, I opted for the Motorola deal.

The time came now to spend some money. Class was scheduled to start in about four weeks, but we wouldn't be using the lab equipment until about the seventh or eighth week. The dean was reluctant at first to spend any money, but at this point there was no alternative. Besides, the tuition from the students already enrolled in the course was enough to cover both my salary and the lab equipment. The dean gave his blessing, and we proceeded from there. I contacted the Motorola representative and informed him of our decision; then I called the local distributor and ordered the equipment. I expected the equipment to be ready in about two to three weeks, about the same time as the beginning of the winter trimester.

The equipment I ordered from the distributor included all the discrete circuitry specified in the assembly instructions. There were still two glaring omissions from the microcomputer system: the power supply and the IO device. In addition, there was the

Continued on page 90

The POLY 88 Microcomputer System

PolyMorphic Systems now offers the complete, assembled, personal computer system—the POLY 88 System 16. A full 16K system with high speed video display, alphanumeric keyboard, and cassette program storage. A BASIC software package providing the most advanced features available in the personal computing market. Features like PLOT and TIME, which utilize our video graphics and real-time clock. Others like VERIFY, so that you know your tape is good before you load another. Or input type-ahead so you can tell your program to run while the tape is still loading (it stores up to 64 characters of commands or question responses to be executed). All these plus a complete package of scientific functions, formatting options, and string capabilities. With the POLY 88 System 16 you can amaze your timesharing friends the very first night!

Polymorphic Systems 11K BASIC — **Size:** 11K bytes.

Scientific Functions: Sine, cosine, log, exponential, square root, random number, x to the y power.

Formatted Output • Multi-line Function Definition • String Manipulation and String Functions • Real-Time Clock • Point-Plotting on Video Display • Array dimensions limited by memory • Cassette Save and Load of Named Programs • Multiple Statements per Line • Renumber • Memory Load and Store • 8080 Input and Output • If Then Else • Input type-ahead.

Commands: RUN, LIST, SCR, CLEAR, REN, CONTINUE

Statements: LET, IF, THEN, ELSE, FOR, NEXT, GOTO, ON, EXIT, STOP, END, REM, READ, DATA, RESTORE, INPUT, GOSUB, RETURN, PRINT, POKE, OUT.

Built in Functions: FREE, ABS, SGN, INT, LEN, CHR\$, VAL, STR\$, ASC, SIN, COS, RND, LOG, TIME, WAIT, EXP, SQRT, CALL, PEEK, INP, PLOT.

Systems Available. The POLY 88 is available in either kit or assembled form. It is suggested that kits be attempted only by persons familiar with digital circuitry.

System 2: is a kit consisting of the POLY 88 chassis, CPU, video circuit card, and cassette interface. Requires keyboard, TV monitor, and cassette recorder for operation. \$735

System 16: consists of an assembled and tested System 2 with 16K of memory, keyboard, TV monitor, cassette recorder, 11K BASIC and Assembler on cassette tapes. \$2250.

System 0: The circuit cards an S-100 mainframe owner needs to be compatible with the POLY 88 software library. System 0 consists of the central processor card with monitor ROM, the video circuit card, and cassette interface, all in kit form. \$525.

Prices and specifications are subject to change without notice. California residents add 6% sales tax.

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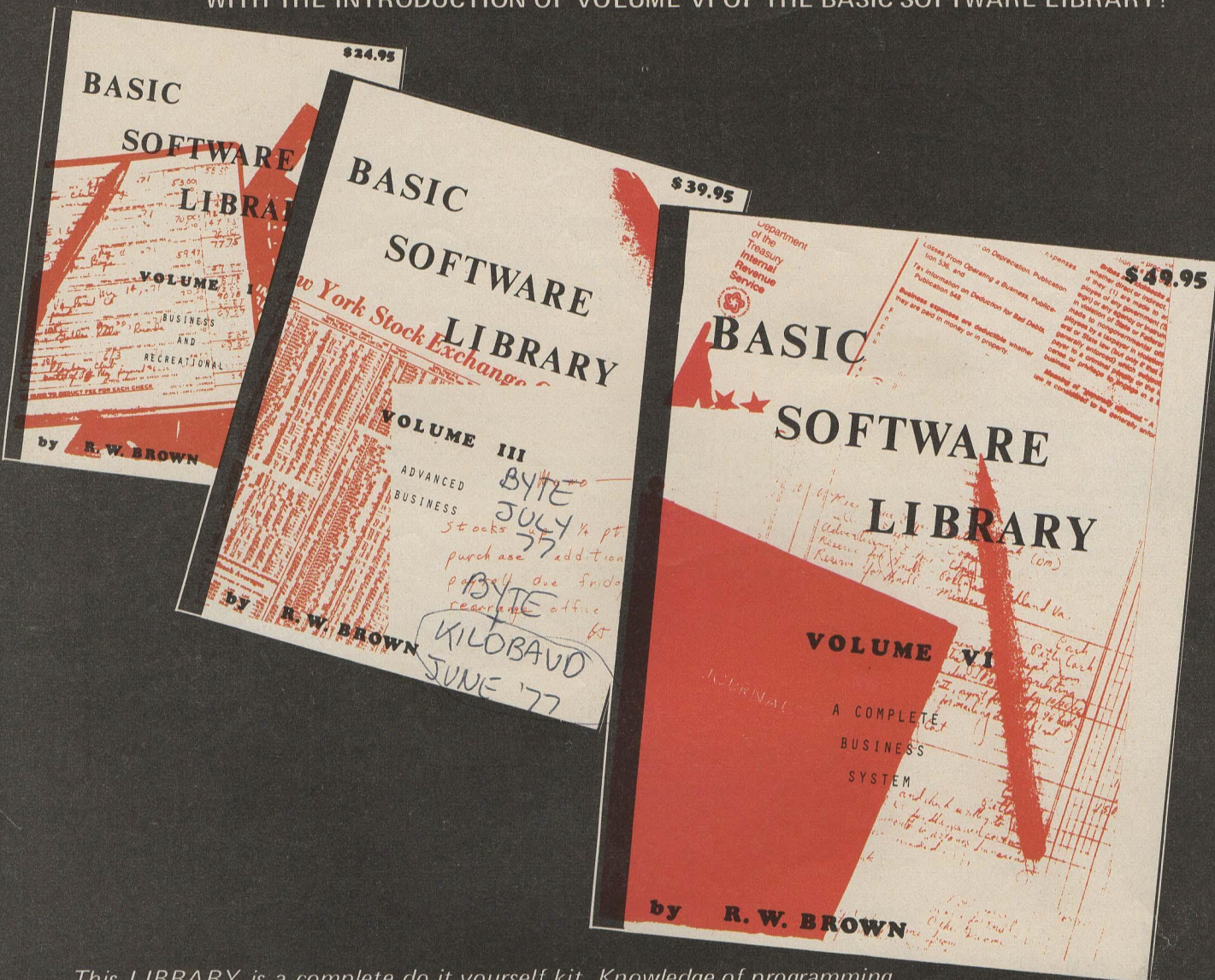
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BUSINESS SOFTWARE

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WITH THE INTRODUCTION OF VOLUME VI OF THE BASIC SOFTWARE LIBRARY!



This *LIBRARY* is a complete do it yourself kit. Knowledge of programming not required. *EASY* to read and *USE*. Written in compatible BASIC immediately executable in ANY computer with at least 4K, NO other peripherals needed.

General Ledger, Billing, A/R, A/P, Payroll, Inventory, P/L, Balance Sheets, Tax Records, more — Volume VI Complete \$49.95. Yes, that's right — we didn't miss the decimal point. And all you need to use it is a Computer that understands BASIC and 20K of available memory with a mass storage device, such as a floppy disk. Add \$2 for shipping and handling.

Hard to believe? Well our Volume III offers Payroll, Inventory, Billing, A/R. etc. for only \$39.95. This volume is intended for use on very small microcomputers with no mass storage or peripheral devices. It is also written in compatible BASIC. Add \$2 for shipping and handling.

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The System 8813 from PolyMorphic Systems is a complete, powerful problem solver in a walnut cabinet. This microcomputer allows you to quickly formulate and solve sophisticated financial, scientific, and engineering models from the convenience of your office or den.

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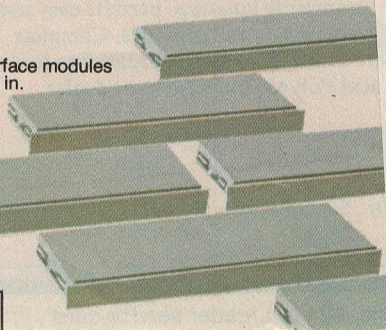
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The POLY 88 Microcomputer System

You can operate a personal financial program, perform a scientific or statistical analysis, and enjoy a growing collection of challenging games. In a couple of evenings you can learn the "BASIC" computer language and begin to write your own programs. At your disposal are high speed video graphics, scientific functions, and formatting features which allow any application to be easily realized.

System 16 consists of an assembled and tested POLY 88 with 16K of memory, keyboard, TV monitor, cassette recorder, 11K BASIC and Assembler on cassette tape. \$1995. **System 2** is a kit consisting of the POLY 88 chassis, CPU, video circuit card, and cassette interface. \$690.

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The POLY 88 Microcomputer System

PolyMorphic Systems now offers the complete, assembled, personal computer system—the POLY 88 System 16. A full 16K system with high speed video display, alphanumeric keyboard, and cassette program storage. A BASIC software package providing the most advanced features available in the personal computing market. Features like PLOT and TIME, which utilize our video graphics and real-time clock. Others like VERIFY, so that you know your tape is good before you load another. Or input type-ahead so you can tell your program to run while the tape is still loading (it stores up to 64 characters of commands or question responses to be executed). All these plus a complete package of scientific functions, formatting options, and string capabilities. With the POLY 88 System 16 you can amaze your timesharing friends the very first night!

PolyMorphic Systems 11K BASIC

Size: 11K bytes.

Scientific Functions: Sine, cosine, log, exponential, square root, random number, x to the y power.

Formatted Output • Multi-line Function Definition • String Manipulation and String Functions • Real-Time Clock • Point-Plotting on Video Display • Array dimensions limited by memory • Cassette Save and Load of Names Programs • Multiple Statements per Line • Renumber • Memory Load and Store • 8080 Input and Output • If Then Else • Input type-ahead.

Commands: RUN, LIST, SCR, CLEAR, REN, CONT.

Statements: LET, IF, THEN, ELSE, FOR, NEXT, GOTO, ON, EXIT, STOP, END, REM, READ, DATA, RESTORE, INPUT, GOSUB, RETURN, PRINT, POKE, OUT.

Built in Functions: FREE, ABS, SGN, INT, LEN, CHR\$, VAL, STR\$, ASC, SIN, COS, RND, LOG, TIME, WAIT, EXP, SQRT, CALL, PEEK, INP, PLOT.

Systems Available. The POLY 88 is available in either kit or assembled form. It is suggested that kits be attempted only by persons familiar with digital circuitry. The following are two of the systems available.

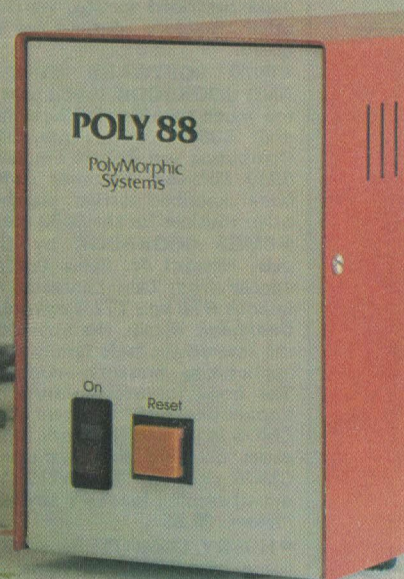
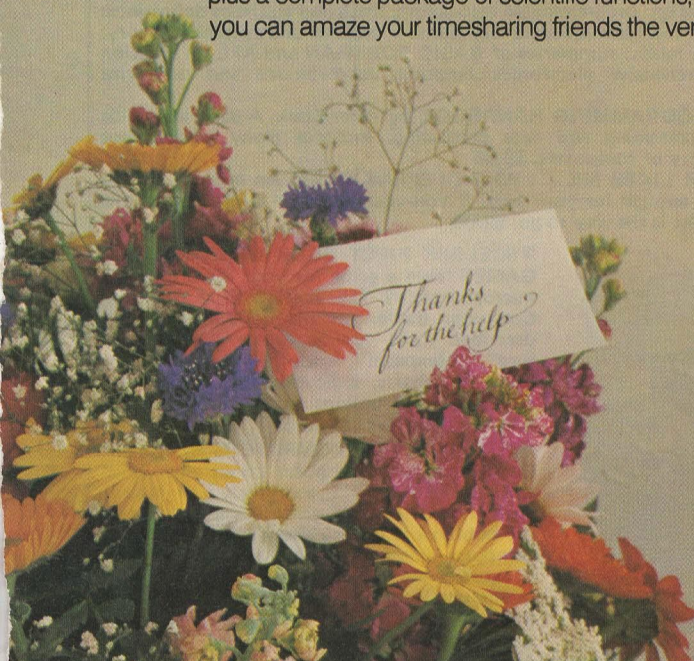
System 2: is a kit consisting of the POLY 88 chassis, CPU, video circuit card, and cassette interface. Requires keyboard, TV monitor, and cassette recorder for operation. \$690

System 16: consists of an assembled and tested System 2 with 16K of memory, keyboard, TV monitor, cassette recorder, 11K BASIC and Assembler on cassette tapes. \$1995.

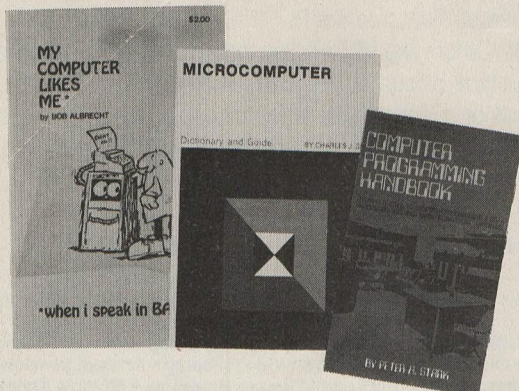
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Over 5000 definitions and explanations of terms and concepts (704 pages) relating to microprocessors, microcomputers and microcontrollers. There are also separate appendices on: programmable calculators; math and statistics definitions; flowchart symbols and techniques; binary number systems and switching theory; symbol charts and tables; summaries of BASIC FORTRAN and APL. In addition there is a comprehensive electronics/computer abbreviations and acronyms section. \$15.95.

● **COMPUTER PROGRAMMING HANDBOOK** by Peter Stark. A complete guide to computer programming and data processing. Includes many worked out examples and history of computers. \$8.95

● **MY COMPUTER LIKES ME ... WHEN I SPEAK BASIC** An introduction to BASIC ... simple enough for your kids. If you want to teach BASIC to anyone quickly, this booklet is the way to go. \$2.00.

● **SCELBI'S GALAXY GAME FOR THE "8008"/"8080"** Here's a new twist in computer games by Scelbi Computer Consulting and Robert Findley. The game, "Galaxy", pits the operator of a spaceship against alien craft, as well as variables such as speed, time and ammunition. No two games are the same! This game is described in *Galaxy Game for the 8008/8080*, published by Scelbi Computer Consulting, Inc. \$14.95.

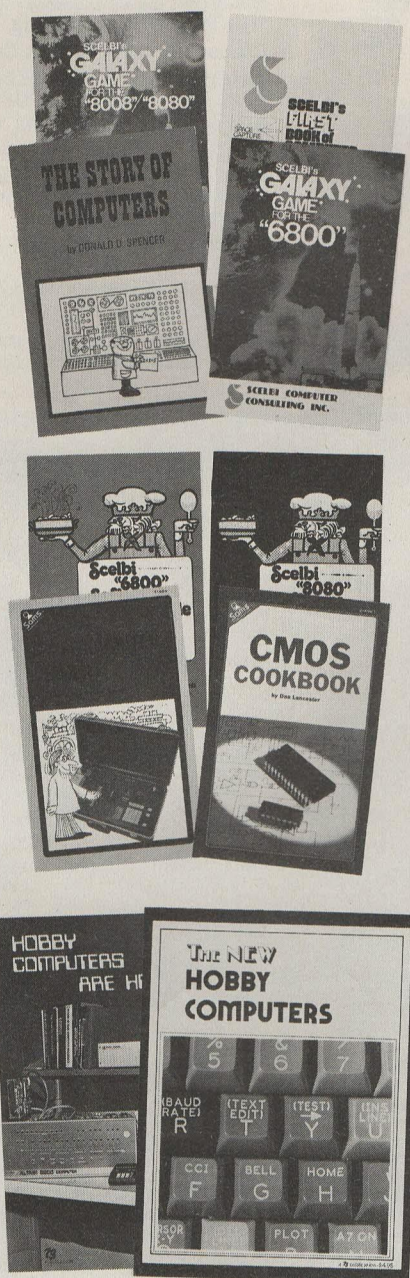
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● **6800 SOFTWARE GOURMET GUIDE & COOKBOOK** If you have been spending too much time developing routines for your 6800 microprocessor, try the new book by Scelbi Computing and Robert Findley. This manual, *6800 Software Gourmet Guide and Cookbook* described sorting, searching, and many other necessary routines for the 6800 user. \$9.95.

● **8080 SOFTWARE GOURMET GUIDE AND COOKBOOK** If you have been spending too much time developing simple routines for your 8080, try this new book by Scelbi Computing and Robert Findley. This manual, *8080 Software Gourmet Guide and Cookbook* described sorting, searching, and many other routines for the 8080 user. \$9.95

● **CMOS COOKBOOK** by Don Lancaster, pub. Howard W. Sams Company. Another winner from Don Lancaster, author of the famous *RTL* and *TTL Cookbooks*. The *CMOS Cookbook* details the application of CMOS, the low power logic family suitable for most applications presently dominated by TTL. The book follows the style of the original Cookbooks. Eight chapters cover all facets of CMOS logic, and the work is prefaced by 100 pages detailing the characteristics of most CMOS circuits. The *CMOS Cookbook* is required reading for every serious digital experimenter. \$9.95

● **HOBBY COMPUTERS ARE HERE** If you (or a friend) want to come up to speed on how computers work ... hardware and software ... this is an excellent book. It starts with the fundamentals and explains the circuits, the basics of programming, along with a couple TVT construction projects, ASCII-Baudot, etc. This book has the highest recommendations as a teaching aid for newcomers. \$4.95.



● **SCELBI'S FIRST BOOK OF COMPUTER GAMES** Need a game for your 8008 or 8080 microprocessor? Try *Scelbi's First Book of Computer Games for the 8008/8080* which described three popular games, "Space Capture", "Hexpaw", and "Hangman". Complete flowcharts, logic description, program listing, and instructions are provided. A must for the game freak! \$14.95.

● **THE STORY OF COMPUTERS** by Donald D. Spencer is to computer books what *Dick and Jane* to novels ... extremely elementary, gives the non-computerist a fair idea of what the hobbyist is talking about when he speaks computer lingo. Attempts to explain what computers are and can do to a spouse, child or any un-electronics-minded friend. \$4.95.

● **MICROCOMPUTER PRIMER** by Mitchell Waite and Michael Pardee, pub. by Howard W. Sams Company. If you are afraid to get involved with microcomputers for fear of not understanding them, worry no longer! The *MICROCOMPUTER PRIMER* describes basic computer theory, explains numbering systems, and introduces the reader to the world of programming. This book does not elaborate on specific systems or chips, but describes the world of microcomputing in "real world" terminology. There is probably no better way of getting involved with the exciting new hobby of microcomputing. \$7.95

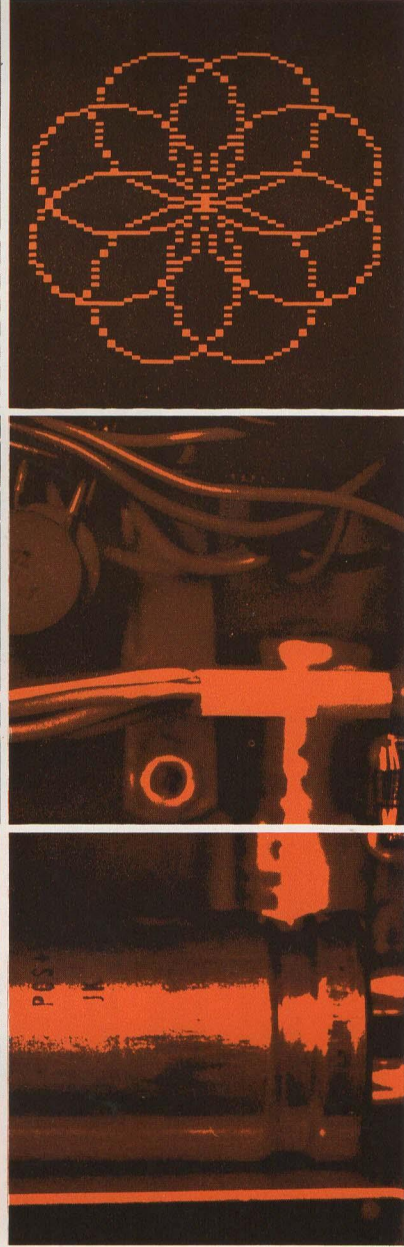
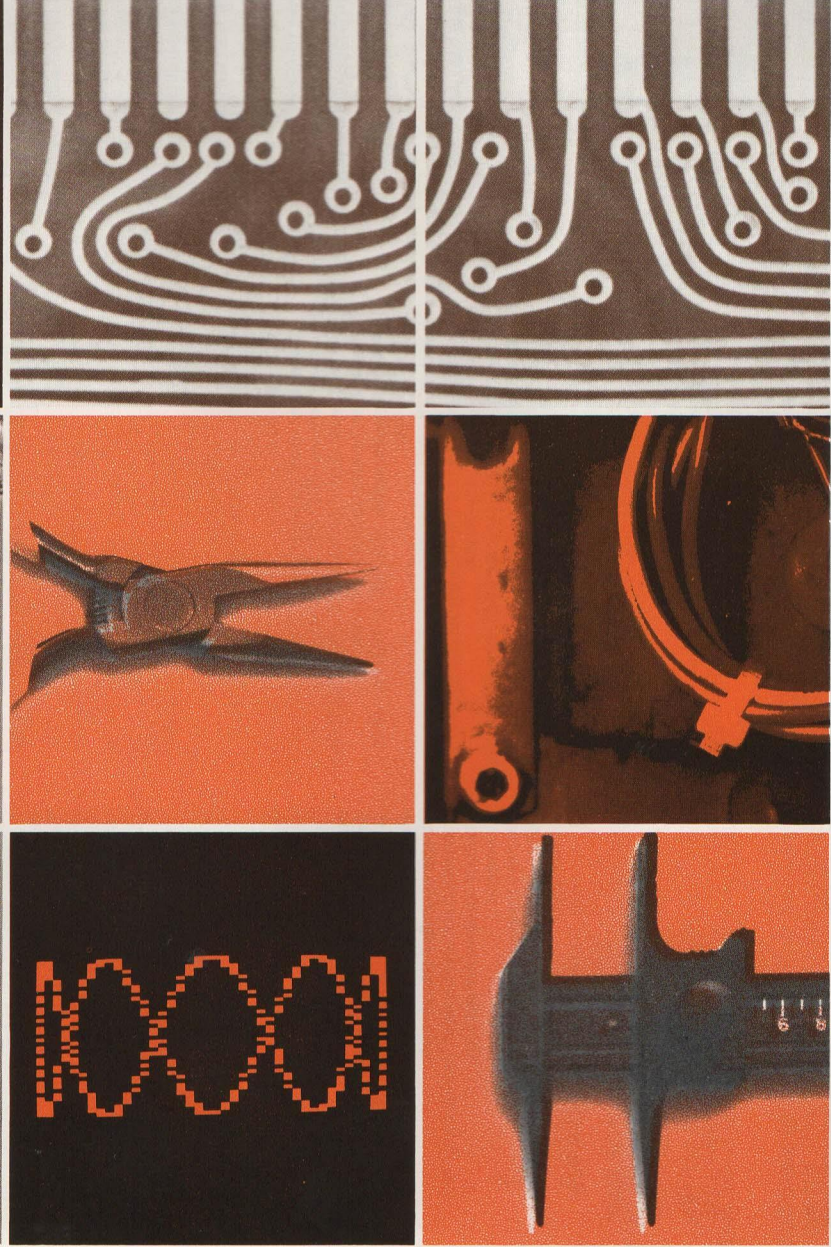
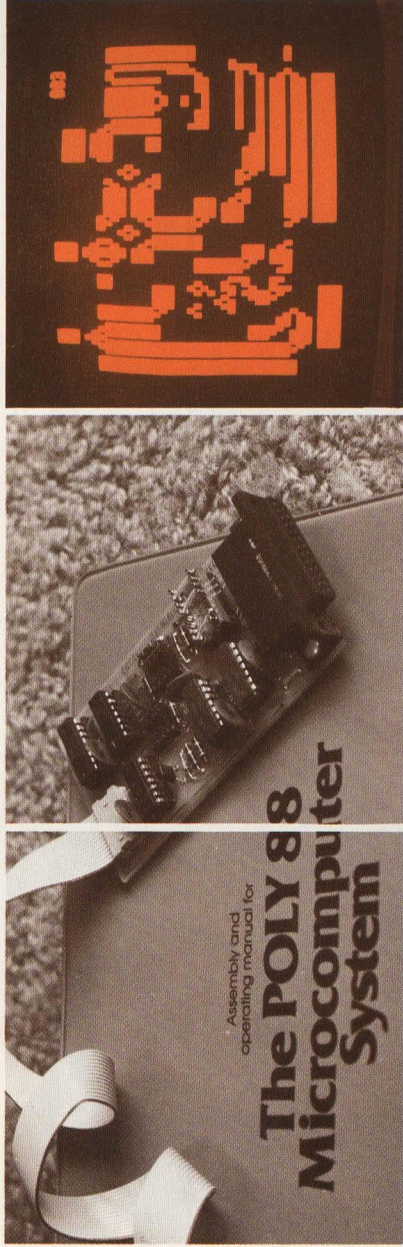
● **INTRODUCTION TO MICROPROCESSORS** by Charles Rockwell of MICROLOG Here is an ideal reference for the individual desiring to understand the hardware aspects of microprocessor systems. This book describes the hardware details of computer devices in terms the beginner can understand, instead of treating the micro chip as a "black box." Addressing schemes, registers, control, and memory are all explained, and general information about hardware systems is provided. Specific systems are not described and programming is only briefly discussed. *Introduction To Microprocessors* is a hardware introduction ... and a good one. \$17.50 US and Canada, \$20 elsewhere.

● **THE NEW HOBBY COMPUTERS!** This book takes it from where "Hobby Computers Are Here" leaves off, with chapters on Large Scale Integration, how to choose a microprocessor chip, an introduction to programming, low cost I/O for a computer, computer arithmetic, checking memory boards, a Baudot monitor/editor system, an audible logic probe for finding those tough problems, a ham's computer, a computer QSO machine ... and much, much more! Everything of interest is there in one volume, ready to be enjoyed by you. \$4.95.

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The POLY 88 Microcomputer System

From his dawn, man has been a tool builder and user: tools have multiplied his strengths and senses. Now the computer arrives as a tool to multiply the powers of the mind and the POLY 88 arrives as the first computer system to be integrated into a personal tool. The POLY 88 system offers, on a personal level, the simplicity, flexibility, power and quality present in the finest of tools. This microcomputer represents the first complete inexpensive personal computer system. With a video display for lightning-fast computer output, and a standard cassette recorder for low-cost program storage, you can do your own home accounting, graphics, scientific simulations, advanced games, or any other information processing application. Designed for easy use by newcomers and computer experts alike, the POLY 88 is as versatile as you, the user, are creative. Quality tools are an integral part of man's interaction with his world. This is such a tool. If you're thinking about expanding your personal capabilities, think about a POLY 88.



BASIC

The handle for the tool.

A microcomputer without software is a tool without a handle. PolyMorphic systems BASIC is the handle on the POLY 88; this provides the interface between user and computer. Our BASIC fits the POLY 88 like a finely balanced handle fits a quality tool. PolyMorphic Systems Basic is an extremely efficient way to program.

It makes possible the immediate use of the POLY 88 for a wide range of engineering, scientific and general problem solving. In conjunction with either System 7 or System 16 PolyMorphic Systems BASIC is the reliable and ready to go microcomputer tool on the market.

No more waiting for the long-promised software system. Among our best BASIC features: graphic plotting function, tape save and dump with named files, time function, and self-explanatory error messages. We believe the best tool — the POLY 88 — must have the best handle: PolyMorphic Systems BASIC.

Polymorphic Systems 11K BASIC

Size: 11K bytes.

Scientific Functions: Sine, cosine, log, exponential, square root, random number, x to the y power.

+ Formatted Output • Multi-line Function Definition • String Manipulation and String Functions • Real-Time Clock • Point-Plotting on Video Display • Arrays of up to 7 Dimensions • Cassette Save and Load of Named Programs • Multiple Statements per Line • Renumber • Memory Load and Store • 8080 Input and Output

If Then Else

Commands: RUN, LIST, SCR, CLEAR, REN, CONT, LINE, NULL
Statements: LET, IF, THEN, ELSE, FOR, NEXT, GOTO, ON, EXIT, STOP, END, REM, READ, DATA, RESTORE, INPUT, GOSUB, RETURN, PRINT, FILL, OUT

Built in Functions: FREE, ABS, SGN, INT, LEN, CHR\$, VAL, STR\$, ASC, SIN, COS, RND, LOG, TIME, WAIT, EXP, SQRT, CALL, EXAM, INP, PLOT.

Systems Available. The POLY 88 is available in either the kit or assembled form. It is suggested that kits be attempted only by persons familiar with digital circuitry. The following is a list of the systems available.

System 1: is a kit and consists of the Poly 88 chassis, CPU and video circuit cards only. Requires keyboard and TV monitor for operation. \$595.

System 2: Consists of System 1 with the addition of the cassette interface circuitry—requires cassette recorder. \$690.

System 3: System 2 with 8K memory card, BASIC and assembler cassette tapes. \$990.

System 4: Also a kit, but containing in addition to System 3 a keyboard, cassette deck and TV monitor. \$1350.

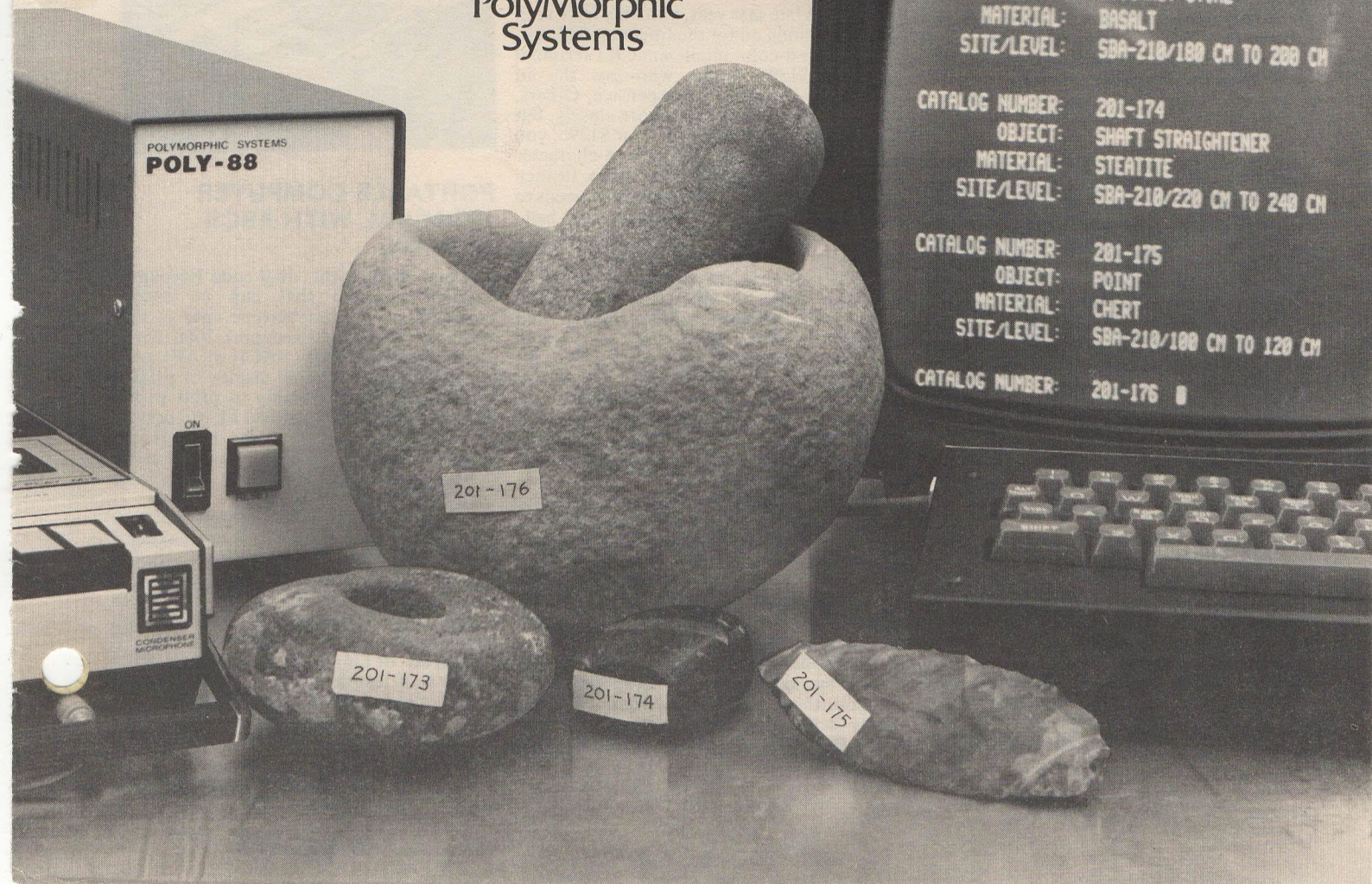
System 7: Consists of an assembled and tested POLY 88 with 8K of memory, keyboard, TV monitor, cassette recorder, 8K BASIC and Assembler cassette tapes. \$1750.

System 16: Consists of an assembled and tested POLY 88 with 16K of memory, keyboard, TV monitor, cassette recorder, 11K BASIC and Assembler cassette tapes. \$1995.

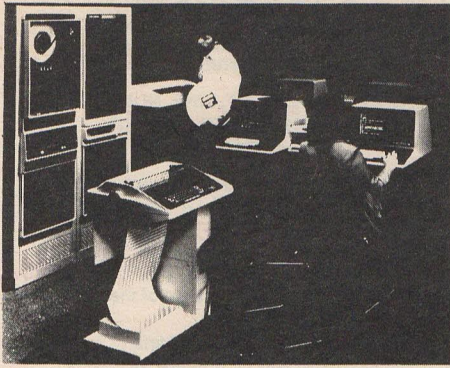
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COMPUTERS

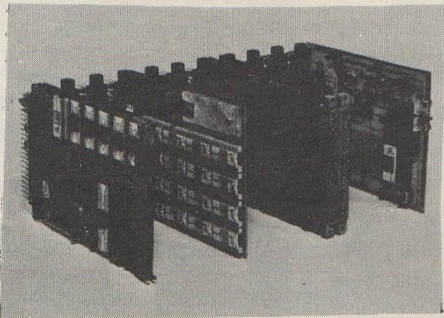


MULTITASK, REAL TIME MEGAMINI

The top of the line Nova 3/D computer uses 32K-word MOS memory modules and features a Memory Mapping and Protection Unit (MMPU) that allows concurrent batch and timesharing. The system supports Fortran IV with real-time extensions, multi-user extended Basic and Algol. This 16-bit "megamini" supports up to 128K words of memory and the complete line of Nova printers, terminals, discs, tape drives and other peripherals.

This system in medium or larger configurations should be of interest to schools for concurrent instructional timesharing and administrative (or instructional) batch. A medium-scale system with 48K memory, 10 megabyte disc and two hard copy terminals would cost around \$37,000. A typical large-scale configuration with 96K memory, two 10 megabyte discs, 75 ips tape drive, 300 lpm printer, two HS hard copy terminals, and 4 CRT terminals would run about \$87,000. Extensive literature available free.

Data General Corp., Route 9, Southboro, MA 01772. (617) 485-9100 X2556.



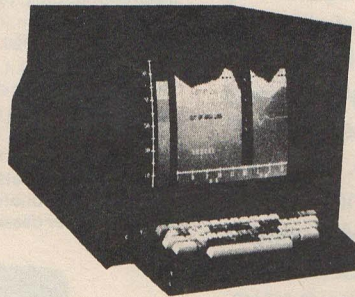
WINTeK REDUCES MICRO PRICE 50% TO \$149, ANNOUNCES FANTOM-11

Wide customer acceptance of its WINCE MICRO MODULES has allowed WINTeK Corporation to halve the price on its single card microcomputer. The price was reduced from \$298 to \$149 for the minimum configuration WINCE CONTROL MODULE consisting of a 6800 MPU, clock and baud rate generator, 1K ROM with FANTOM-11, 128 byte RAM, and ACIA (UART serial I/O) or PIA (16 TTL lines parallel I/O). The price for the maximum

configuration module consisting of 6800 MPU, clock and baud rate generator, 1K ROM with FANTOM-11, 512 byte RAM, ACIA (UART serial I/O) and 2 PIA's (32 TTL lines parallel I/O) was reduced from \$398 to \$199. All WINCE modules (control, RAM, ROM, EROM programmer, A/D, etc.) are on industry standard 4½" x 6½" inch printed circuit boards.

FANTOM-11 is a new 1K monitor/debug program that allows single step execution of user programs, insertion and deletion of break points, and set up of interrupt vectors. It also allows the user to load memory, examine and/or change memory, print and/or punch memory, display MPU registers, go to user's programs, and reset.

WINTeX Corp., 902 N. 9th St., Lafayette, Ind. 47904. (317) 742-6802.



A COMPLETE 8-COLOR INTELLIGENT CRT TERMINAL KIT

Up until late last year, you may have seen an eye-catching ad for the Intecolor 8001 kit, "a complete 8-color intelligent CRT terminal kit," for \$1395. Some who saw the ad considered the 8001 too expensive. Others, who read the specs a little more closely, felt the price was within reason. For \$1395, you got an 8080 MPU, 25-line by 8-character display, 4k RAM, PROM firmware, 19-inch color CRT, RS-232 I/O, selectable speeds to 9600 baud, ASCII set, keyboard, and bell.

There's a new ad now, which says "It's an intelligent terminal for \$1395. Or your personal computer for an additional \$1295." The total price for the personal computer isn't given, perhaps on the theory that putting the \$2690 amount in print might scare away even the aficionados. For the extra \$1295 you get BASIC on ROM, additional 8k RAM workspace, insert/delete, background color, lower-case ASCII characters, roll, 48 lines instead of 25, 2X character height, "and a graphics mode with 160X192 elements."

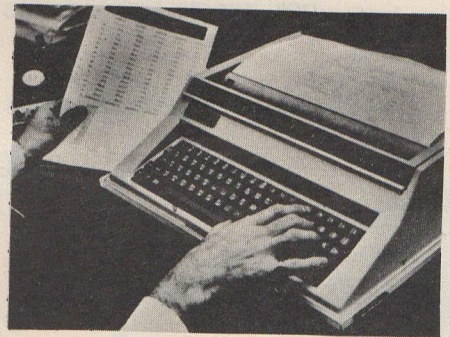
Intelligent Systems was marketing the \$1395 intelligent terminal kit to hobbyists, and an assembled unit to OEMs (original equipment manufacturers) and commercial users for \$1995 (\$1776 during a limited period, one to a customer). The assembled 8001 will still be available to OEMs, but the future of the \$1395 kit is uncertain, and there is talk of phasing out both Intecolor kits. The hobby market has been just too difficult to support; there are too many phone calls, and many "screwed up" 8001 cards are sent in by hobbyists who can't get the terminal to work.

Starting last December, for \$2995, a subsidiary company, Compucolor Corp., provides a similar terminal, assembled, also with BASIC and 19-inch screen, but sold only through computer stores. The Compucolor 8001 features an optional, separate "floppy tape memory," which turns out to be an 8-track audio cartridge, with a continuous loop, and single and dual drives. The shortest tape is 36 inches long, providing 16k bytes of storage, and a maximum retrieval time of 5 seconds. For more storage, use a longer tape. There may possibly be a Compucolor 8001 kit, at around \$2495.

A cartridge library is in the works, to eventually include graphics, computations, check-book balancing, education instruction and tutoring, and computer games, including Star Trek.

For current information on these units, contact Intelligent Systems Corp., 5965 Peachtree Corners East, Norcross, GA 30071, (404) 449-5961.

TERMINALS



PORTABLE COMPUTER TERMINAL WITH ASCII AND APL

A new lightweight, dual code Execuport portable terminal that can be carried anywhere in an attache-type case is now available. The new Execuport 3000 Series terminals provide both ASCII or APL code operation and a graphic display of printed data based on their ability to print with a resolution of 240 (24 vertical by 10 horizontal) points per square inch. This unique graphic printing capability is made possible by the simultaneous movement of the print head and paper positioning.

Desk-top weight of the lightest model in the new series is only 22 lb. 8 oz. making it completely portable. A built-in acoustic coupler that accepts an ordinary telephone handset makes it possible for the terminal to communicate with a remote computer from any location with telephone service. It accepts 80- or 136-column paper rolls in 100 or 180 foot lengths.

Out of paper alarm, Bell decoder, 20 MIL TTY Loop, and many other options are available. The Model 3000 is completely

The POLY 88 Microcomputer System is here!



POLY 88 is a complete, solid and trustworthy personal computer. No technological background is required to enjoy this versatile machine.

The POLY 88 is the invaluable tool for the home and office. With it, children can play or even develop their own mathematical and scientific games. Simple or Complex equations and projections can be programmed, stored and altered in the BASIC programming language. The POLY 88 starts at \$595 in kit form.

If you are in need of a quality tool, the POLY 88 is it.

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_____ that you will refund the purchase price of the kit if it is not in saleable condition within 10 days of receipt.

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The POLY 88 Microcomputer System

If you are into computers or considering a system, the
POLY 88 is the machine to contemplate.

HARDWARE

- Popular 8080 central processor • Single-board CPU with ROM, RAM, vectored interrupt, real time clock, single-step logic and serial I/O • Video interface card – generates video to TV monitor and provides parallel keyboard input port • Serial and cassette mini-cards plug directly into CPU with ribbon cables • Cassette
- ROM monitor with powerful debugger, video software, bootstrap loader • Backplane and power supply on one board simplifies construction • Rugged 6 amp power supply • All circuit boards are high quality, double-sided with plated-through holes • System is compatible with a wide range of Altair peripherals • Minimum point to point wiring means that the POLY 88 kit can go together in three evenings!

ABOUT SOFTWARE

Software is the reason the POLY 88 was designed. The operator can proceed from higher level languages like BASIC to developing machine code with the aid of our assembler. Our BASIC is a full 8K BASIC with character and byte manipulation. Best of all, the programmer is finally free of the teletype emulation mode so the video display can be used to full advantage.

The video display provides a unique opportunity to write new types of programs and games. Characters (16 lines of 64) and graphics (48 by 128 grid) are part of the processor's memory, so the display may be altered rapidly — the entire screen written in less than 20 milliseconds.

POLY 88 hardware provides many additional features that programmers have come to expect, such as vectored interrupt and real time clock.

See it at your local computer store.

ARE YOU NEW TO COMPUTERS?

The POLY 88 was designed for ease of use. No one should have to learn all the inner workings of computers just to enjoy one at a reasonable price. With the POLY 88, you can "play" pre-developed programs or explore the world of computer languages as your interests expand.

THE POLY 88 IS FOR EVERYONE

Want to develop a new computer language? Want to fight Klingons? The POLY 88 provides a firm foundation upon which to build your interests and develop your skills.

POLY 88 SYSTEM PRICES:

SYSTEM 1 — Kit includes 8080 vectored interrupt processor with real time clock, ½ K of RAM and 1K monitor on ROM: Video Terminal Interface displays 16 lines of 32 characters on a video screen and has a keyboard input port; cabinet, backplane, and power supply; complete assembly, operation and theory manual. \$595.

SYSTEM 2 — System 1 plus 64 character line option and Byte/biphase cassette interface kit. \$690.

SYSTEM 3 — System 2 plus 8K of RAM with BASIC and assembler programs on cassette tape. \$990.

SYSTEM 4 — The complete kit. It includes system 3 and TV monitor, keyboard and cassette recorder with all necessary cables and connectors. \$1350.

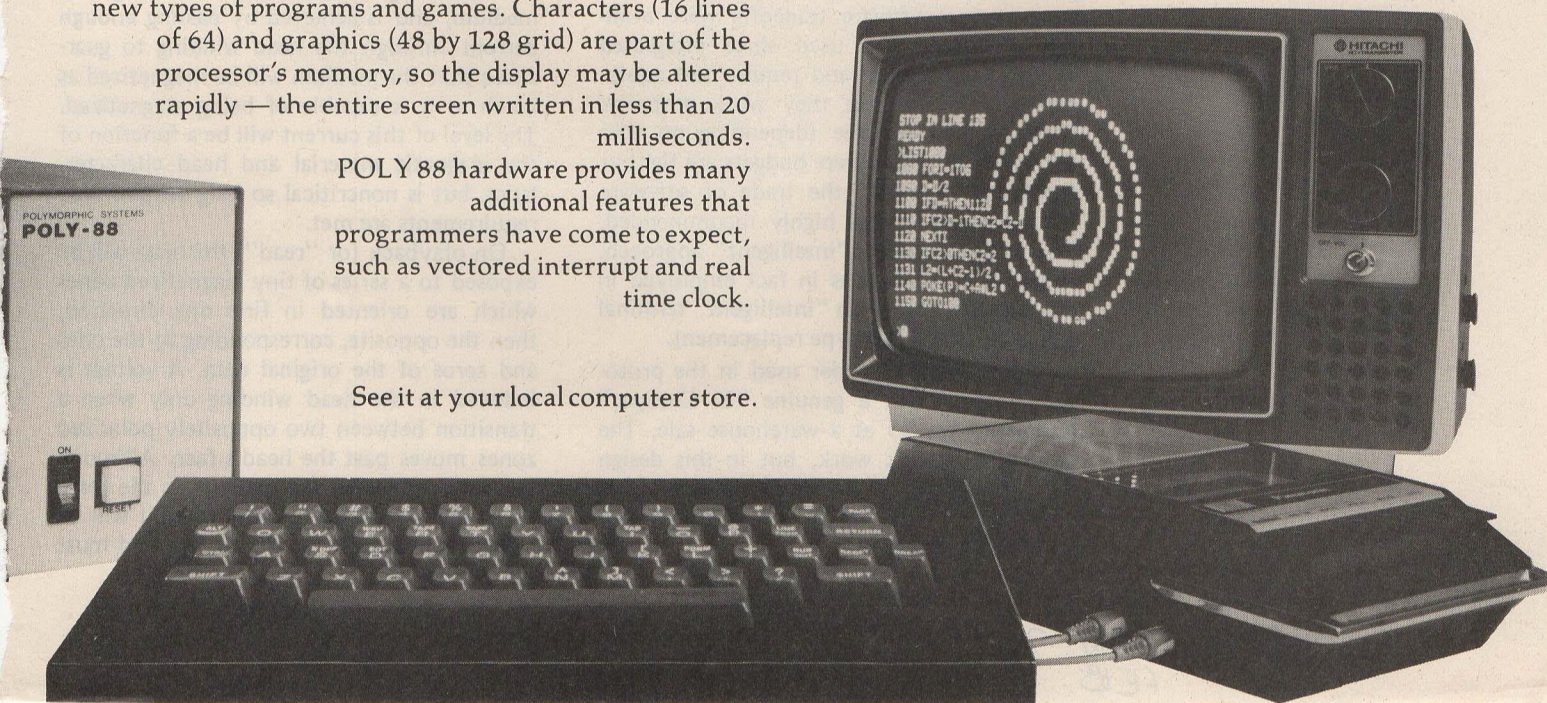
SYSTEM 7 — System 4 assembled, tested and ready to run. \$1750.

ACCESSORIES — 8K RAM kit, \$300. Assembled \$385
POLY I/O Ideaboard, hardware prototyping kit board. \$55.
Analog Interface (1 channel) kit. \$145.

Prices effective until January 15, 1977. Prepaid orders shipped postpaid.

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Saturation Recording's Not All That Hard

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Kansas City KS 66102

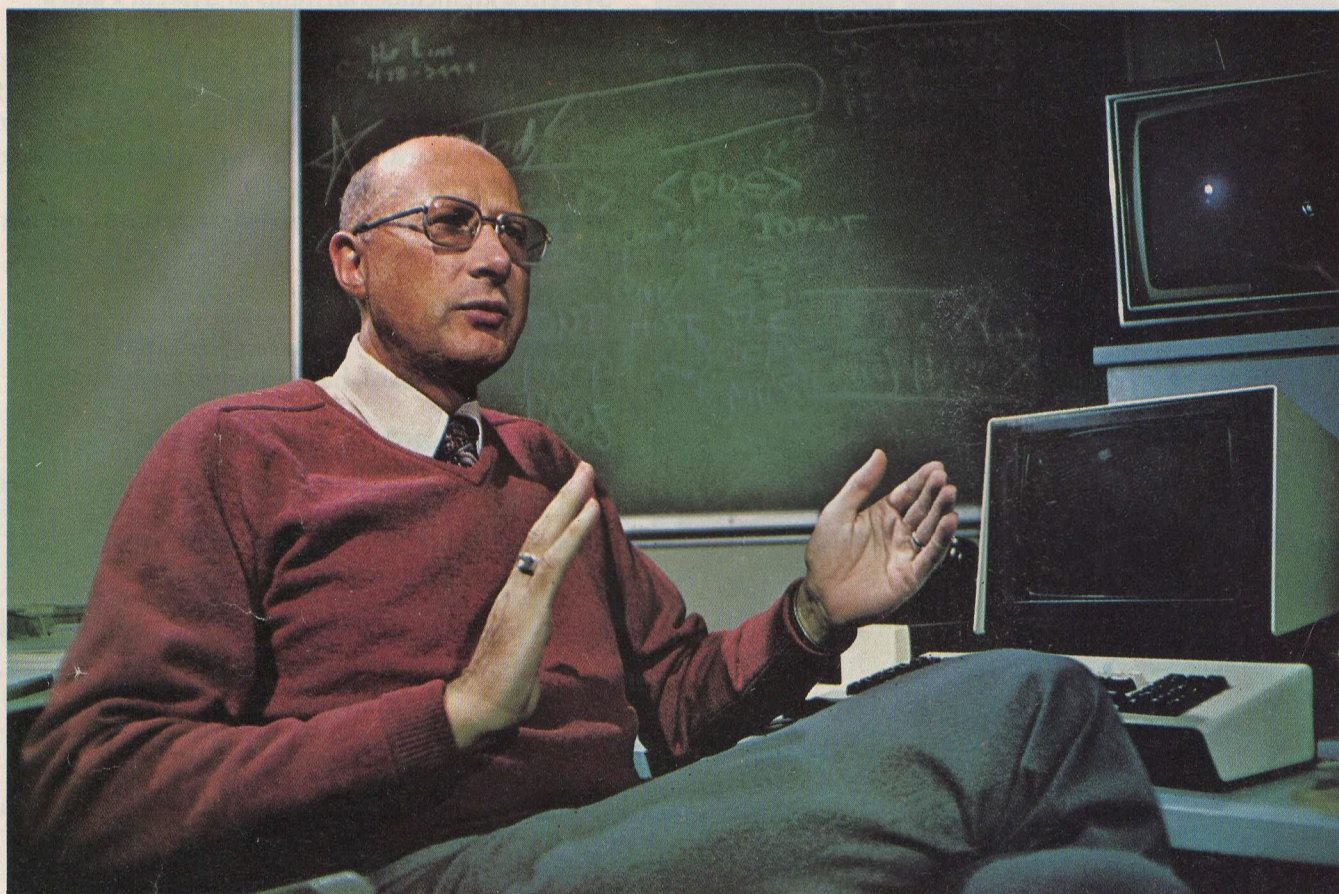
The cassette recorder is doubtless the most common and popular peripheral device among hobbyists, and considerable attention has been paid to its employment. Almost all of this attention has been directed toward the use of unmodified audio recorders. This complicates a simple problem. Saturation recording is the logical way to store digital data on tape, so why use audio? Saturation recording is more straightforward, more flexible, and inherently more reliable. The design presented here uses only a few garden variety integrated circuits; no PLLs, no UARTs. It presupposes no encoding scheme, so the user is free to pick and choose among the various techniques available. I used ordinary NRZ (Non Return to Zero) ASCII because it was easiest to write software for. The hardware in this design is extremely simple; software is used for encoding and decoding as well as the serial to parallel and parallel to serial conversions. Where hardware versus software tradeoffs were available, software was used since integrated circuits cost money and require test equipment to insure that they work properly. Software can be free (depending on who writes it) and thus where budgets are tight or flexibility desirable, the trade of software for hardware comes highly recommended. This is the so-called "intelligent" approach, and this interface was in fact employed in the construction of an "intelligent" terminal which I use as a Teletype replacement.

The cassette recorder used in the prototype system was a genuine "El Cheapo," purchased for \$5 at a warehouse sale. The electronics didn't work, but in this design the electronics are not used anyway only the head and motor are used and must be in good condition.

The Pragmatics of Saturation Recording

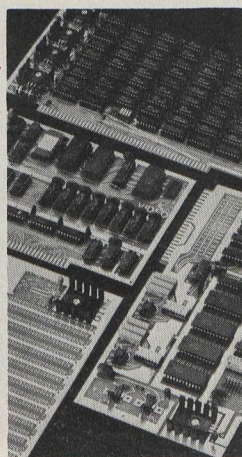
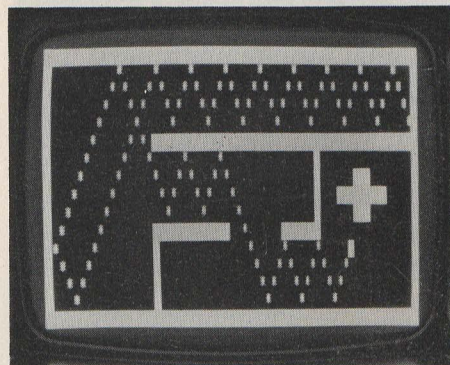
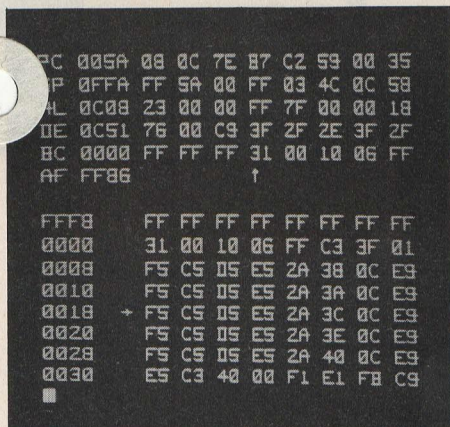
During recording (or "writing"), only a single signal is impressed onto the magnetic medium; there is no carrier, nor bias signal. The signal itself, at any given instant, will be in one of two states: full positive or full negative. Note that while the digital data may be discussed in terms of ones and zeros, it is written on tape as +1s and -1s where the value 1 refers to saturation of the magnetic medium [see *BYTE*, March 1976, page 18]. To accomplish this in a cassette recorder, it is necessary only to pass a small direct current through the winding of the combined record and playback head. Polarity of the saturation recorded signal (+ or - 1) will be determined by the direction of current flow through the head winding. The magnitude of the recorded signal will be that corresponding to saturation of the magnetic medium, and is achieved by passing enough current through the head winding to guarantee that the medium will be magnetized as much as it is capable of being magnetized. The level of this current will be a function of the magnetic material and head characteristics, but is noncritical so long as minimum requirements are met.

On playback (or "read") the head will be exposed to a series of tiny magnetized zones which are oriented in first one direction, then the opposite, corresponding to the ones and zeros of the original data. A voltage is induced in the head winding only when a transition between two oppositely polarized zones moves past the head's face. Although the data resides on the medium in the form of zones of constant magnitudes, it will be sensed in the form of transitions, and must



“Generally, you have to assume that passing criminal laws never ‘solves’ the problem. There’s a criminal element in society that’s always there, ready to take advantage of everything that comes along, every innovation, every new loophole.”

BYTE DEC 76



POLY 88 System Prices

System 1 kit includes 8080 vectoral interrupt processor board with real time clock, ½K of RAM, and 1K monitor on ROM; Video Terminal Interface for displaying 16 lines of 32 characters on video screen and inputting keyboard signals; cabinet, backplane, and power supply; complete assembly, theory, and operation manual. \$595.

System 2 kit includes all items in System 1 and a Byte/biphase cassette interface kit. \$690.

System 3 kit includes System 2 plus 8K of RAM with BASIC and assembler programs on cassette tape. \$990.

System 4 is the complete kit. It includes System 3 with TV monitor, keyboard, and cassette recorder with all necessary cables and connectors. \$1350.

System 7 is System 4 assembled, tested, and ready to run. \$1750.

Accessories:

8K RAM kit. \$300. Assembled \$385.

POLY I/O Ideaboard, hardware prototyping kit board. \$55.

Analog Interface (1 channel) kit. \$145.

All prices and specifications subject to change without notice. Prices are U.S.A. only. Calif. residents add 6% sales tax. Prepaid orders shipped postpaid. Bankamericard and Master Charge accepted.

If you haven't seen the POLY 88 yet, why don't you wander down to your local dealer and see what personal computing can be like.

WEST

- Bits N Bytes, 679D S. State College Blvd., Fullerton, CA 92631 (714) 879-8386
- Byte Shop Arizona, 3237 S. Fairfield Dr., Tempe, AZ 85282 (602) 894-1129
- Byte Shop Campbell, 2559 S. Bascom, Campbell, CA 95008 (408) 377-4685
- Byte Shop Mountain View, 1063 W. El Camino Real, Mountain View, CA 94040 (415) 969-5464
- Byte Shop Palo Alto, 2227 El Camino Real, Palo Alto, CA 94306 (415) 327-8080
- Byte Shop Pasadena, 496 S. Lake Ave., Pasadena, CA 91101 (213) 684-3311
- Byte Shop Portland, 2033 SW Fourth Ave., Portland, OR 97201 (503) 223-3496
- Byte Shop San Fernando Valley, 18424 Ventura Blvd., Tarzana, CA 91356 (213) 343-3919
- Byte Shop Walnut Creek, 2989 N. Main St., Walnut Creek, CA 94596 (415) 933-6252
- Byte Shop Westminster, 14300 Beach Blvd., Westminster, CA 92683 (714) 894-9131
- The Computer Center, 8205 Ronson Rd., San Diego, CA 92111 (714) 292-5302
- Computer Components, Inc., 5848 Sepulveda Blvd., Van Nuys, CA 91411 (213) 786-7411
- The Computer Mart, 625 W. Katella # 10, Orange, CA 92667 (714) 633-1222
- Computer Systems Unlimited, 18886 Hesperian Blvd., Hayward, CA 94541, Hrs. W-F, by appt., S&S 1-7 (415) 278-2667

MIDWEST

- Computer Workshop of Kansas City, 6903 Blair Rd., Kansas City, MO 64152 (816) 741-5050
- The Computer Room, 1455 S. 1100 East Salt Lake City, UT 84105 (801) 466-7911
- *The Data Domain, 111 S. College, Bloomington, IN 47401 (812) 334-3607
- *The Data Domain, 7027 N. Michigan Rd., Indianapolis, IN 46224 (317) 251-3139
- itty bitty machine company, 1316 Chicago Ave., Evanston, IL 60201 (312) 328-6800
- The Micro Store, 634 S. Central Expwy., Richardson, TX 75080 (214) 231-1096

EAST

- Micro Computer Systems, Inc., 144 S. Dale Mabry Hwy., Tampa, FL 33609 (813) 879-4301/4225
- Elecon Corp., "The Computer Store", 4921-72 Ave. No., Pinellas Park, FL 33565 (813) 541-3021
- Computer Shop 11111111, Route 16B, Union, NH 03887 (603) 473-2323
- Computer Workshop, 5709 Frederick Ave., Rockville, MD 20852 (301) 468-0455
- Hoboken Computer Works, No. 20 Hudson Pl., Hoboken, NJ 07030 (201) 420-1644
- The Computer Mart of New Jersey, Inc., 151 Kline Blvd., Colonia, NJ 07067 (201) 574-2173

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737 S. Kellogg, Goleta, CA 93017
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The POLY 88 Microcomputer System

The POLY 88 is not for everybody; but if you are into computers, or considering getting a system, the POLY 88 is a machine to think about.

For the hardware buff:

- Popular 8080 central processor • Single-board CPU with vectored interrupt, real time clock, single step logic, and serial I/O • Video interface card to handle communications — generates video to TV monitor and provides parallel keyboard input port • Serial and cassette interfaces on small mini-cards that plug directly into CPU board with ribbon cables • 300 baud cassette • ROM monitor with powerful debugger, video software, and bootstrap loader • Backplane and power supply on one board simplifies construction
- Rugged 6 amp power supply • All circuit boards are high quality double sided with plated through holes
- System is compatible with a wide range of Altair peripherals on the market • Minimum point to point wiring means that the POLY 88 kit can go together in three evenings!

Front Panel Display:

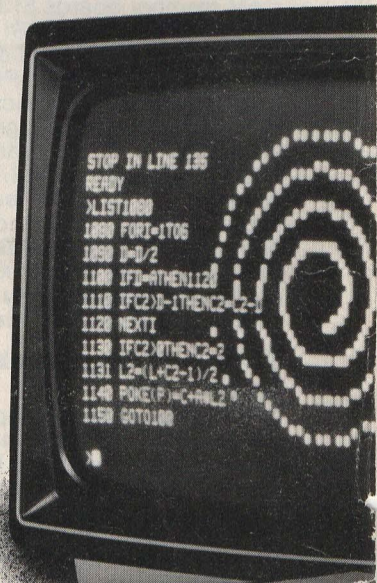
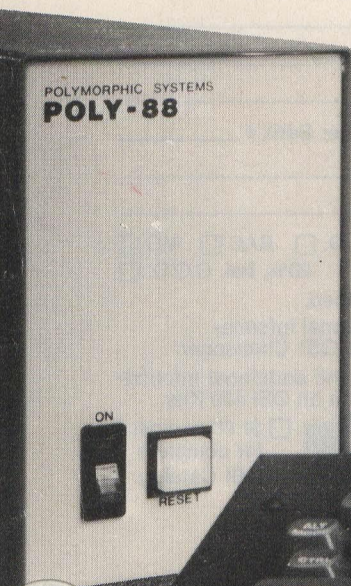
Routines in the 1024 byte monitor display the contents of each of the 8080 internal registers, and the value in memory that is addressed by each register pair. Programs may be executed one instruction at a time. Data at any location in memory can be displayed and may be easily altered. All front panel data is entered in hexadecimal notation for operator convenience.

For the software buff:

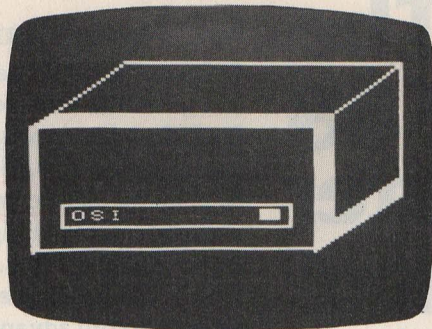
Software is what the POLY 88 was designed for. The user can go all the way from using higher level languages like BASIC to developing machine code with the aid of our assembler. Our BASIC is a full 8K BASIC with character and byte manipulation capabilities; and it is designed to run on our system. No kludging up or special fixes needed to run on multiple I/O devices. Best of all, the programmer is finally free of the teletype emulation mode so the video display can be used to full advantage. The video display provides a unique opportunity to write new types of programs and games. Characters (16 lines of 64) and graphics (48 by 128 grid) are part of the processor's memory, so the display may be altered extremely fast — less than 20 milliseconds to write the entire screen. The 1024 byte ROM monitor provides many I/O handling routines, leaving the programmer free to concentrate on his particular application. The POLY 88 hardware provides many of the additional features that programmers have come to expect from computer systems, such as vectored interrupt (which allows multiple concurrent I/O handling) and real time clock. These features are standard equipment and are included in every POLY 88. So, whether you want to develop a new computer language or fight Klingons, the POLY 88 hardware provides a firm foundation on which to realize your programming fantasies.

For the person new to computers:

For those of you who are just getting started with computers the POLY 88 is a machine that was designed to be easy to use. No complicated hardware setup and software fixes needed. No one should have to learn all the inner workings of a computer just to enjoy one at a reasonable price. With the POLY 88, you can "play" pre-developed programs and then explore writing programs in either BASIC or assembly language, as your interests expand.



Meet the Challenger.™



The Challenger
Self Portrait

The new price and performance champ from OSI.

He's got his act together!

Even our lowest-cost Challenger comes fully assembled, complete with a 500 ns 6502A, serial interface, 1,024 words of memory and a UL-approved power supply, all for \$439. Every Challenger comes ready for easy expansion with an 8-slot mother board, backplane expansion capability, and a power supply heavy enough to handle a full complement of system boards. Our 4K Challenger comes ready to run BASIC minutes after you unpack it. And there's more.

He packs some heavy hardware.

You've never seen memory and interface options like these—not at our prices, fully assembled! 4K RAM memory boards \$139! (see below). Single drive OSI Challenger Floppy Disk \$990! Dual drive Floppy \$1490! Plus 8K PROM boards! A Video Graphics board, including alphabetics, graphics, and **color!** An audio cassette, A/D, D/A and parallel I/O board! A backplane extender board! A prototyping board! And our extraordinary **CPU Expander Board**—it lets you run a Z-80, and 6100 (PDP-8 equivalent) **concurrently** with The Challenger's 6502, or under its control.

There's nothing soft about his software!

OSI has full software support for our Challengers. Including extended BASIC, extended Video Monitor, a Disk Operating System, some very Hollywood real time programs for Video Graphics, Animation, Sound Processing and so forth, plus PROM firmware, with more to come.

He's fast!

You can order The Challenger with a 6502C for a 250 ns cycle time, with a standard 6502A for 500 ns cycle time, or with a 6800 for 1 microsecond cycle time. And with

our CPU Expander Board, you can always update to any new CPU to be as fast as fast can be.

And he isn't just good!

He's better! By design. The OSI Challenger is the only completely-assembled, ultra-high-performance, fully-expandable mainframe computer that does this much for this little. Get your hands on one now. Send for your Challenger today.

You can't beat The Challenger!

The OSI Challenger 65-1K. Fully assembled. Features 6502A CPU, serial interface, 1,024 words of memory. **\$439.**

The OSI Challenger 65-4K. Same as 65-1K but with 4,096 words of memory. Will run Tiny BASIC without expansion. **\$529.**

The OSI Challenger 65V-4K. NO NEED for an expensive terminal. Connects to your ASCII keyboard and video monitor through included OSI 440 Video Board. Features software utility that simulates a deluxe CRT terminal. **\$675.**

The OSI Challenger 68-1K. Based on 6800 CPU. For the casual hobbyist, smaller systems. The Challenger 68 series comes only in serial interface forms and is compatible with MIKBUG software through an included OSI software utilities package. **\$459.**

The OSI Challenger 68-4K. With OSI 4K BASIC on paper tape. **\$529**
SPECIAL! ADDITIONAL 4K MEMORY BOARDS. Ordered with your Challenger, limit 3 more at this special Low Price, (total 16K, including 4K already on-board in mainframe). **\$139**
Buy 12K or larger Challenger 65 system and we include Extended BASIC FREE!

OSI Challenger Floppy Disk System. Fully assembled, for use with OSI Computers only. **\$990** Single drive **\$1490** Dual drive.

OSI Audio Cassette Interface. Comes assembled, but with room for you to populate with A/D and D/A chips later. (OSI 430 based) **\$89**
And all the baseboards and kits of the powerful OSI 400 System.

OK, OSI, I'm ready to buy!

To order your Challenger System, send the total amount of your purchase plus \$4.00 for shipping and insurance (plus sales tax for Ohio orders) by personal money order or check. Or indicate **all** numbers on your BankAmericard or Master Charge to charge your order. Or send a 20% (non-refundable) deposit to receive your order C.O.D. Delivery is typically 60 days (except when payment is by check, which must clear before shipment can be made). Deliveries are scheduled on a first ordered, first shipped basis.

Name _____

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Expiration Date _____

Account # _____

Check ☐ M. O. ☐ BAC ☐ MC ☐
20%, bal. C.O.D. ☐

☐ Order attached.

☐ Send additional information on The OSI Challenger.

☐ Send additional information on OSI 400 Kits.

☐ \$1.00 enclosed for complete OSI Catalog.

OSI

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(216) 569-7945

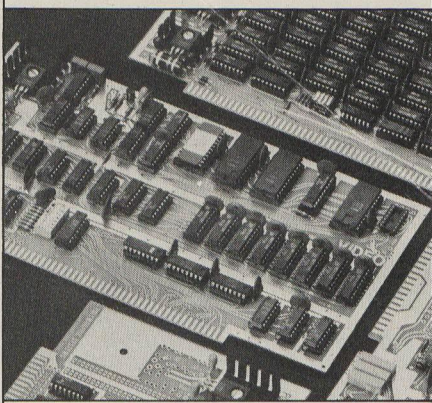
CIRCLE 23

BYTE DEC 76
JANUARY/FEBRUARY 1977

Personal Computing

47

Computer Peripherals available from PolyMorphic Systems



The Video Terminal Interface circuit card generates 16 lines of 32 or 64 characters (depending on option) on a standard video monitor or slightly modified TV set. Characters are stored in a 1/2 or 1K RAM on the video board. Display capability includes graphics and text. Text includes all keyboard characters including upper and lower case, in a clear, highly readable 7 x 9 dot matrix font. Graphics characters are made up of 2 x 3 grid in each character position, allowing for display of a 48 by up to 128 contiguous grid on a TV screen. The entire screen may be updated in 20 msec. The Video Terminal Interface circuit card also includes an 8 bit parallel keyboard input port, allowing the board to function as the complete computer interface.

The Video Terminal Interface includes standard software, allowing scroll and page modes, insert/delete, and full cursor control. Literature covers kit-building, testing, trouble-shooting, and software.

The PolyMorphic POLY VTI is the only "Altair-compatible" video terminal interface with keyboard input port and full graphics.

Prices: 32 character line kit — \$185
64 character line kit — \$210
Assembled \$280

Other peripherals available from PolyMorphic Systems includes an 8K RAM board, a versatile prototyping board ("The Ideaboard"), and an Analog Interface.

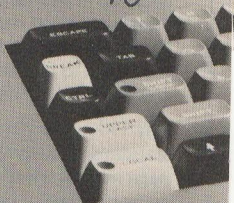
All prices and specifications subject to change without notice. Prices are USA only. California residents add 6% sales tax. Prepaid orders shipped postpaid. BankAmericard and Master Charge accepted.

PolyMorphic Systems

737 S. Kellogg Avenue, Goleta, Ca. 93017
(805) 967-2351

So Termina Compu
So Termina Compu
So Termina Compu

BYTE NOV
76



The POLY 88 Microcomputer System

The POLY 88 Microcomputer System brings to the user, in one compact package, the capability of developing programs and hardware as well as enjoying the interaction with computers.



The POLY 88 System uses a video monitor for display, a keyboard for input and cassette tape for storage. The system will also connect to a hard-copy terminal. Poly 88 hardware consists of an 8080 based CPU circuit card with on-board memory and I/O, video display circuit card with keyboard input port and graphics capability, and mini-cards that connect to the CPU board via ribbon cable for cassette or serial interface.

The Firmware Monitor is integral to the POLY 88 System. This 1024 byte program in ROM allows the user to display data on a TV screen, enter data into memory using a keyboard, read and dump data to the cassette interface in Kansas City format, and single step through a program while displaying the contents of each of the 8080's internal registers.

Prices: Basic kit including chassis, CPU and video cards — \$595, \$795 assembled. Cassette option — \$90 kit and \$125 assembled. 8K of RAM — \$300 in kit form or \$385 assembled.

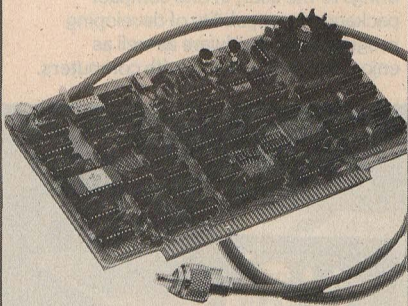
Dealers: This system will sell itself.

All prices and specifications subject to change without notice. Prices are USA only. California residents add 6% sales tax. Prepaid orders shipped postpaid. BankAmericard and Master Charge accepted.

PolyMorphic Systems

737 S. Kellogg Avenue, Goleta, Ca. 93017
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Does your computer talk to you?



The intelligence of your 8080 system is only as great as its capacity to communicate. Processor Technology's **VDM-1** will function as a highly cogent link to that intelligence. This **ultra-high speed output device** plugs into your Altair or IMSAI to provide fast, versatile human interface. It generates 16 lines of display: 64 characters each, **both upper and lower case**. 1024 bytes of random access memory are on the card. The VDM-1 scrolls upwards or downwards, up to a top speed of **2000 lines per minute!** Any combination of cursors (up to 1024) can be displayed as black-on-white or vice versa—perfect for video games. The VDM-1 will work with any standard video monitor, or your own TV set can be easily modified. The module comes with **free terminal mode software**, for teletype replacement when used with BASIC or assemblers.

Our detailed VDM-1 Owner's Manual is available for \$4, refundable with purchase of the VDM-1.

Kit Price: (eff. 7/1/76): **\$199**
(premium grade, low profile IC sockets included).



Write Us,
about our other
plug-in modules,
compatible with
the 8800 system,

Processor Technology

6200-N Hollis Street
Emeryville, CA 94608

The POLY 88 Microcomputer System

The POLY 88 Microcomputer System brings to the user, in one compact package, the capability of developing programs and hardware as well as enjoying the interaction with computers. The POLY

88 System uses a video monitor for display, a keyboard for input, and cassette tape for storage. The system will connect to a hard-copy terminal. POLY 88 hardware consists of CPU circuit card with on-board memory and I/O, video display circuit card with keyboard input port and graphics capability, and mini-cards that connect to the CPU board via ribbon cable for cassette or serial interface.

Central Processor Card features 512 bytes of RAM (random access memory), plus sockets for up to 3K of 2708-type PROM or ROM (read only memory), vectored interrupt, and real time clock, as well as an optional serial input-output port featuring software-controlled baud rate.

The Video Terminal Interface circuit card will generate 16 lines of 32 or 64 characters or 48 x 128 graphics grid on a standard video monitor or slightly modified TV set. It also includes an 8 bit parallel keyboard input port, allowing the board to function as the complete computer interface.

The POLY 88 Chassis and backplane/motherboard is Altair compatible, and will provide 6 amps of power to five cards. Only two switches are mounted on the front panel — a lighted on/off switch, and a push-button, which, in addition to resetting the system, indicates a halt condition in the processor.

The firmware Monitor is integral to the POLY 88 System. This 1024 byte program in ROM allows the user to display data on a TV screen, enter data into memory using a keyboard, read and dump data to the cassette interface in a standard format, and single step through a program while displaying the contents of each of the 8080's internal registers.

The monitor provides many of the standard driving routines to greatly simplify the job of programming. The monitor forms the basis of an ever-increasing software library available to POLY 88 owners.

Options from PolyMorphic Systems include a board with 8K of additional RAM, a versatile prototyping board ("The Ideaboard"), and an Analog Interface. Also, many "Altair-compatible" products on the market are compatible with this system. **Prices:** Basic kit including chassis, CPU and video cards — \$595, \$795 assembled. Cassette option — \$90 kit and \$125 assembled. 8K of RAM — \$300 in kit form or \$385 assembled. We also sell the video and other "Altair-compatible" circuit cards separately.

Dealers: This system sells itself.

All prices and specifications subject to change without notice. Prices are USA only. California residents add 6% sales tax.



Prepaid orders shipped postpaid. BankAmericard and Master Charge accepted.

☐ Please send more information

☐ Order and check enclosed

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Zip _____

BankAmericard _____ Expires _____

Master Charge _____ Expires _____

Signature _____

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**PolyMorphic
Systems**

its task is complete, the subroutine returns control to the point in the main program from which it was called. Subroutines are designed to work on any variables they receive. This is an important point, as we shall see, and one which gives rise to the most infuriating bugs ever to plague programmers. If the wrong variable is somehow passed to the subroutine (arguments passed to subroutines are called "parameters"), the variable's value will change without the programmer's being aware of it. This error will most likely ripple through the entire program, causing further problems in the program's operation which can continue undetected until the programmer finds that his output is gibberish. The process of isolating and neutralizing this sort of bug is generally long and troublesome.

A module, on the other hand, is designed to avoid these difficulties from the start. Like a subroutine, a module is a body of code which performs a single task; and, like some subroutines, it has only one point of entry and only one exit. This means that whenever a module is employed, it starts at a well defined beginning, goes through a particular process to accomplish its task, and stops its activity at a single point. There is, however, an essential difference between modules and subroutines. The *only* variables which a module can change are those which it has been designed to use for receiving data from the control module and for making information available for other modules to use. This restriction completely rules out the possibility of its changing any *common* variable (i.e., one which can be accessed and used by more than one module) which is not *specifically* designated for its use. Within its own structure a module may perform operations on internal

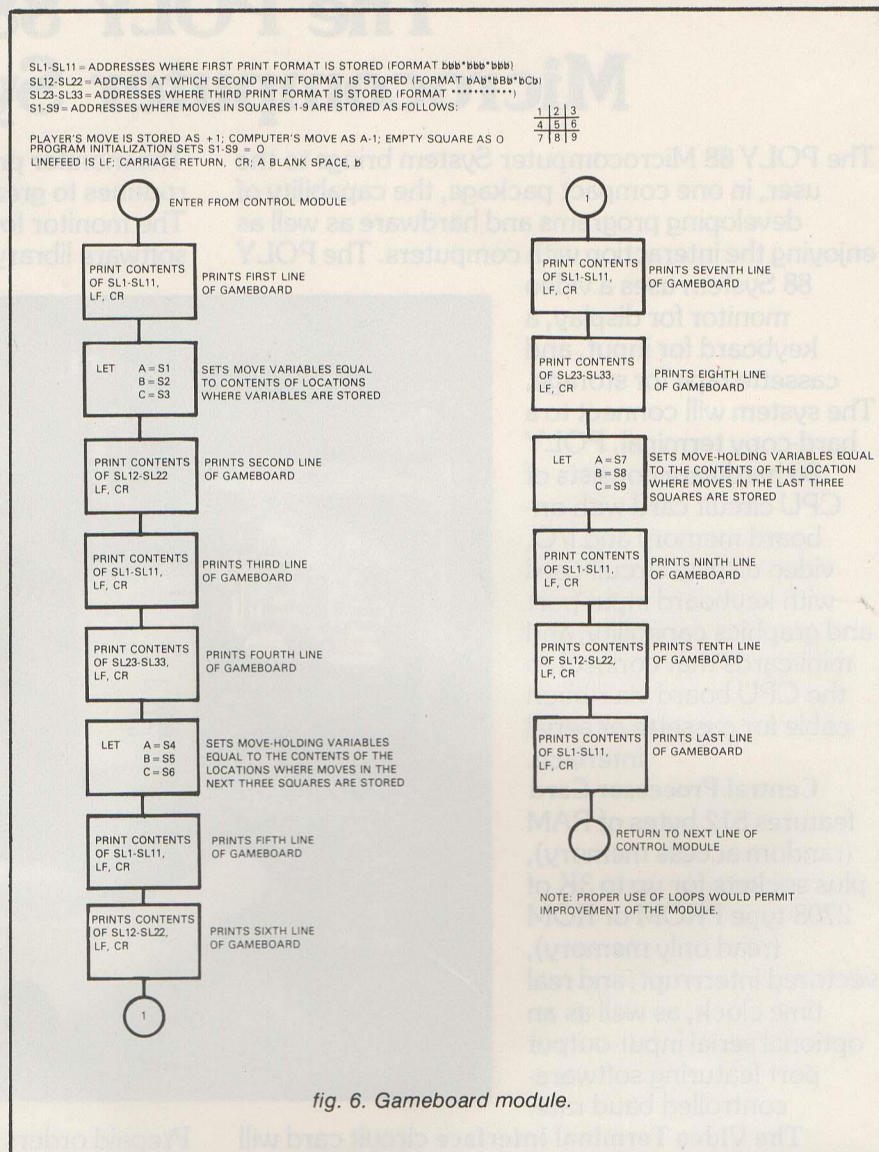


fig. 6. Gameboard module.

variables (called *local* variables), but since these variables will never appear outside that particular module, no mysterious catastrophic failures can occur.

linking variables

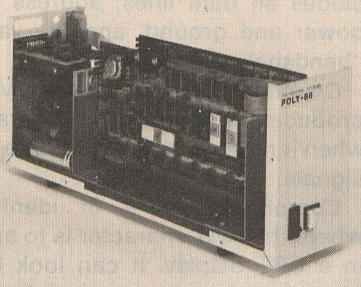
Returning to **fig. 5**, let's see how the I/O module operates according to our concept of modularity. First, the I/O module accepts and uses the variable called I/O, set by the control module, to decide whether it is to perform an input or an output operation; but it doesn't change the value of I/O, and I/O is only used by the I/O module and the control module. These two variables provide the sole link

between the I/O module and the rest of the program. With only these two links, there is little possibility of the I/O module spreading errors through the rest of the program. That, in a nutshell, is the advantage of modular programming. It also points out the care which must be taken in preparing the control module to assure that all common or "global" variables are in a form acceptable to any modules which use them. This is rarely difficult, however, since frequently only the control module and one other functional module will share some common variable. Also, the care required in establishing common variables is counterbalanced by

THE POLY 88 MICROCOMPUTER

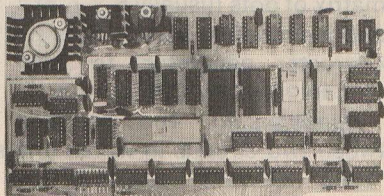
A Complete Microcomputer System
with Keyboard Input and Video Output

The Hardware: The heart of the POLY 88 microcomputer, the CPU circuit card, features an 8080A central processor, 512-byte RAM, space for 3K of PROM, vectored interrupt and real time clock, a dual serial port with software-selectable baud rate, and single-step logic



that allows the processor to execute one instruction at a time.

The POLY 88 also includes our video terminal interface circuit card, which is both a video display device and an input port for a keyboard. Sixteen lines of up to 64 characters may be displayed on a standard TV monitor or modified receiver. In addition to the 128 ASCII characters



which are displayed in an easy-to-read 7 x 9 font, there are 64 graphics characters available for plotting on a 48 x 128 contiguous grid.

These two circuit cards fit into a compact "Altair-compatible" chassis with room for up to five cards. A 6 amp power supply is built right on the mother board. The front panel consists of just two switches, on/off and reset; the monitor software with video screen and keyboard eliminates the need for a hardware front panel. As your system grows, you can plug chassis together for easy expansion. (The expansion connector also eliminates the need for an extender card.) Cassette, RS-232, and current loop interfaces are available which connect via ribbon cable to CPU board and mount on backpanel.

The Software: Supplied with the POLY 88 microcomputer is a 1024-byte monitor on ROM. The program is there when the power is turned on, so you don't need to key in a loader. The monitor is designed to use a keyboard entry and TV display, with a cassette or paper tape as the storage medium.

With the monitor you can: load data into memory in hex, display memory in hex, dump or read data from a storage device, and execute program one step at a time, displaying the contents of each of the 8080 registers as well as the values in memory at the address of each of the

A	B	C	D	E	H	L	SP	PC
3BC3	0DF0	0CFF	0C80	0CFF	0C01			
(BC)	C3	3B	F0	0D	FF	0C	80	0C
(DE)	8D	21	00	88	75	23	7C	FE
(HL)	00	00	00	00	00	00	00	00
(SP)	8D	21	00	88	75	23	7C	FE
(PC)	00	00	00	41	00	06	80	78
.C00V								
0C00	00	00	00	00	41	00	06	80
0C08	78	01	00	20	CD	4D	0C	00
0C10	47	36	A0	19	36	0E	3E	20
0C18	A5	C4	25	0C	3E	03	A4	CC
0C20	38	0C	C3	08	0C	78	07	3F
0C28	1F	DA	32	0C	01	02	00	C3
0C30	48	0C	01	FE	FF	C3	48	0C

registers. All of these functions are available the instant you turn on the power.

Future software available with this system will include BASIC, an assembler, and games.

Prices: Basic kit including chassis, CPU and video cards — \$595, \$795 assembled. Cassette option — \$90 kit and \$125 assembled. 8K of RAM — \$300 in kit form or \$375 assembled. We also sell the video and other "Altair-compatible" circuit cards separately.

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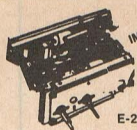
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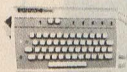


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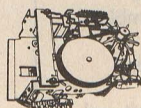
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tions of computer expressions:

Bootstrap. A brief set of instructions to the MPU that allows the computer to accept input data and directs how to handle it. Putting in BASIC via a tape is a good example. This brings up the question of why the bootstrap can't be put on the tape. It can't because it has to "tell" the computer to look at a particular input port and do something with the data about to come in.

Bus. A set of communications lines that makes electrical contact with all the devices plugged into the bus (memory, I/O ports, etc.) The bus includes all data lines, address lines, power and ground, and the various "handshaking" signals.

Character Generator. A ROM that produces alphanumeric characters when it receives the appropriate input signals.

Cursor. A means of identifying where the next character is to appear in a CRT display. It can look like a block, an under or over dash line, and it can be fixed or blinking.

DMA. Direct-memory access. This is a technique for getting directly to the memory, using some special control signals and circuitry.

Dot Matrix. A method of creating alphanumeric characters by using a matrix of dots (usually 5 x 7, or 7 x 9) and illuminating certain dots (via the character generator) to form the character on the CRT screen.

Handshaking. The interface between two circuits in which one side "asks" for data, accepts it from the other circuit, and then acknowledges it.

Hard Copy. Printed material such as received on a Teletype or typewriter.

K. Abbreviation for thousand. Usually used in expressions such as 4K or 8K memory. This really means 4096 or 8192 bytes.

Modem. Acronym for modulator-demodulator. A means of interfacing between a data system and a communications channel (such as the phone line) and into another data system.

Parity. This is an error-testing technique (all data systems are not infallible) in which one special bit is used to make the total of 1's in a word an even or odd number. If a transmission error occurs, and there is an odd (or even) number of 1's, then an error is signaled.

Programming. This defines the sequence of events that a computer must follow.

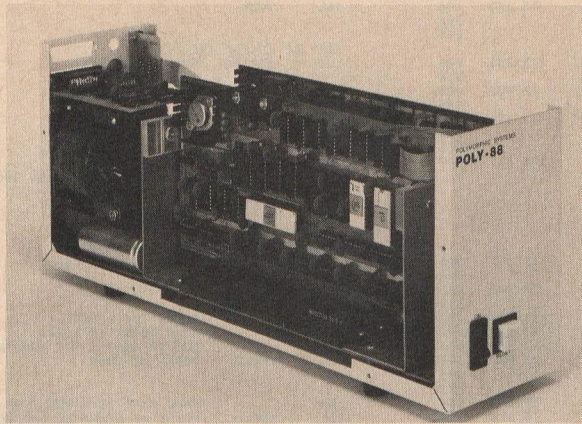
PE OCT 76

ELECTRONIC EXPERIMENTERS HANDBOOK '77

THE POLY 88 MICROCOMPUTER

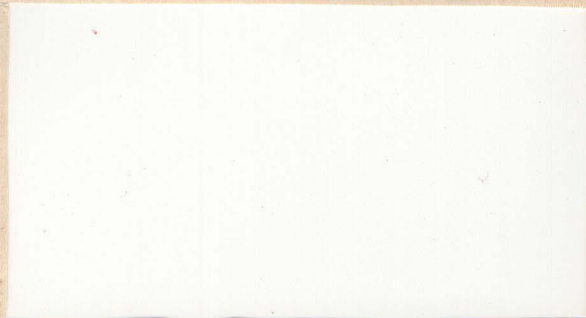
A Complete Microcomputer System with Keyboard Input and Video Output

The Hardware: The heart of the POLY 88 microcomputer, the CPU circuit card, features an 8080A central processor, 512-byte RAM, space for 3K of PROM, vectored interrupt and real time clock, a dual serial port with software-selectable baud rate,



and single-step logic that allows the processor to execute one instruction at a time.

The POLY 88 also includes our video terminal interface circuit card, which is both a video display device and an input port for a keyboard. Sixteen lines of up to 64 characters may be displayed on a standard TV monitor or modified receiver. In addition to the 128 ASCII characters which are displayed in an



easy-to-read 7x9 font, there are 64 graphic characters available for plotting on a 48 x 128 contiguous grid.

These two circuit cards fit into a compact "Altair-compatible" chassis with room for up to five cards. A 6 amp power supply is built right on the mother board. The front panel consists of just two switches, on/off and reset; the monitor software with video screen and keyboard eliminates the need for a hardware front panel. As your system grows, you can plug chassis together for easy expansion. (The expansion connector also eliminates the need for an extender card.) Cassette, RS-232, and current loop interfaces are available which connect via ribbon cable to the CPU board and mount on the backpanel.

The Software: Supplied with the POLY 88 microcomputer is a 1024-byte monitor on ROM. The program is there when the power is turned on, so you don't need to key in a loader. The monitor is designed to use a keyboard entry and TV display, with a cassette or paper tape as the storage medium.

With the monitor you can: load data into memory in hex, display memory in hex, dump or read data from a storage device, and execute program one step at a time, displaying the contents of each of the 8080 registers as well as the values in memory at the address of each of the registers. All of these functions

A F	B C	D E	H L	SP	PC
3BC3	0DF0	0CFF	0C80	0CFF	0C01
(BC)	C3 3B	F0 0D	FF 0C	80 0C	
(DE)	8D 21	00 88	75 23	7C FE	
(HL)	00 00	00 00	00 00	00 00	
(SP)	8D 21	00 88	75 23	7C FE	
(PC)	00 00	00 41	00 06	80 78	
.C00V					
0C00	00 00	00 00	41 00	06 80	
0C08	78 01	00 20	CD 4D	0C 00	
0C10	47 36	A0 19	36 8E	3E 20	
0C18	A5 C4	25 0C	3E 03	A4 CC	
0C20	38 0C	C3 08	0C 78	07 3F	
0C28	1F DA	32 0C	01 02	00 C3	
0C30	48 0C	01 FE	FF C3	48 0C	

are available the instant you turn on the power.

Future software available with this system will include BASIC, an assembler, and games.

Prices: Basic kit including chassis, CPU and video cards — \$595, \$795 assembled. Cassette option — \$90 kit and \$125 assembled. 8K of RAM — \$300 in kit form or \$375 assembled. We also sell the video and other "Altair-compatible" circuit cards separately.

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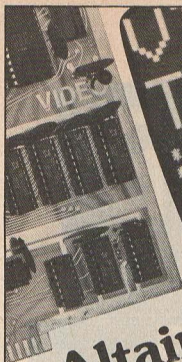
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Systems

23	313	150	JTZ	OUTEND	/DONE!
		342			
		023			
23	316	100	JFC	DSH	/DOT OR DASH?
		327			
		023			
23	321	106	CAL	DOT	/YES A DOT, SO KEY OUT A DOT
		120			
		021			
23	324	104	JMP	OTLOOP	/NEXT SYMBOL
		332			
		023			
23	327	106	DSH,	CAL	DASH
		126			/MUST BE A DASH, SO KEY A DASH
		021			
23	332	303	OTLOOP,	LAD	
		021		NDI	/GET THE CHAR BACK TO THE A REG
23	333	044		177	/THROW OUT THE USED BIT
		177			
23	335	002		RLC	/ROTATE IN AN UNUSED BIT
23	336	330		LDA	/SAVE THE NEW IMAGE IN D
23	337	104		JMP	/LOOP FOR OTHER SYMBOLS
		311			
		023			
23	342	106	OUTEND,	CAL	TICK
		061			/INTER LETTER SPACE
		021			
23	345	106	CAL	TICK	
		061			
		021			
			/SET UP TO POP THE STACK		
23	350	066	LLI	OTFIFO	/POINT AT STACK
		364			
23	352	056	LHI	OTFIFO~	
		025			
23	354	106	CAL	POP	/POP THE STACK
		014			
		021			
23	357	007	RET		/NEXT TASK
			/END OF THE OUTPUT ENCODED DRIVE TASK SUBROUTINE		

			/SUBROUTINE TASK TO OUTPUT CODE
23	230	056	OTPUT, LHI OTFIFO /POINT AT STACK
		025	
23	232	066	LLI OTFIFO
		364	
23	234	250	XRA /CLEAR THE A REG
23	235	207	ADM /CHAR COUNT TO A AND FLGS
23	236	053	RTM /NEXT TASK, IF NOTHING TO DO
23	237	106	CAL INCLH /POINT AT THE DATA
		046	
		021	
23	242	307	LAM /CHARACTER TO A REG
23	243	074	CPI DELETE /ERROR CHARACTER?
		177	
23	245	110	JFZ OTPUT1 /NO, GO TRANSLATE
		264	
		023	
23	250	036	LDI 7 /YES, DO 8 DOTS
		007	
23	252	106	OTERR, CAL DOT /1 DOT
		120	
		021	
23	255	031	DCD /-1 THE COUNT
23	256	110	JFZ OTERR /NOT DONE....DO IT AGAIN
		252	
		023	
23	261	104	JMP OUTEND /DONE, POP AND EXIT
		342	
		023	
23	264	106	OTPUT1, CAL XLATER /TRANSLATE
		040	
		023	
23	267	330	LDA /SAVE THE CHAR IN D REG
23	270	074	CPI 200 /IS IT A BAD CHAR (OR A SPACE)?
		200	
23	272	110	JFZ GOODCH /CHAR OK, SO DO IT UP RIGHT
		311	
		023	
			/IF HERE GENERATE A CHARACTER SPACE
23	275	036	LDI 6 /SET UP FOR 7 UNITS DELAY(UNITS-1)
		006	
23	277	106	SPACE, CAL TICK /WAIT ONE UNIT
		061	
		021	
23	302	031	DCD /DECREMENT THE UNIT COUNTER
23	303	110	JFZ SPACE /LOOP UNTIL DONE
		277	
		023	
23	306	104	JMP OUTEND
		342	
		023	
23	311	074	GOODCH, CPI 200 /IF A=200 THEN DONE
		200	

66

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Altair, Imsai, Polymorphic, compatible products

Video Terminal Interface: Connects to standard TV monitor or modified receiver to display 16 lines of 32 or 64 characters. Characters are formed in a 7 x 9 matrix for easy readability. Character set includes 128 upper and lower case ASCII characters and 64 graphic characters for plotting on a 48 x 64 (48 x 128 with memory option) array. An 8-bit input port is provided for the keyboard. Characters are stored in the onboard memory, which may be read out of or written in to by the computer. Cursor control, text editing, and graphics software is included. \$185 (32 char.) kit. \$210 (64 char.) kit.

Poly I/O Idea Board: This will save you a lot of time in making prototype circuits. I/O port address is selectable with dip switch, and inputs and outputs are fully buffered. \$55 kit.

Analog Interface: Good for interfacing your computer to an analog world. Ten bits of resolution in and out. \$145 for one channel and \$195 for two channels (kit).

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8K RAM on a single board. Connection for battery backup. \$300 kit.

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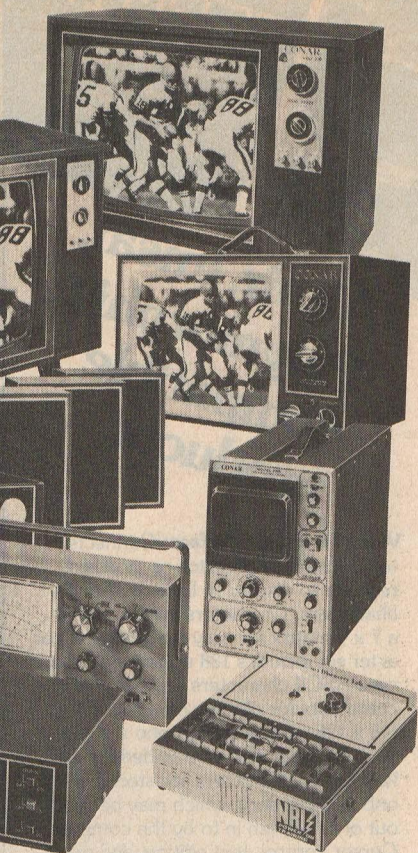
You've probably been hearing about the POLY 88 microcomputer system that uses keyboard and video. We don't have the space here to describe all the features. See it at your local computer store.

Support your local computer store.

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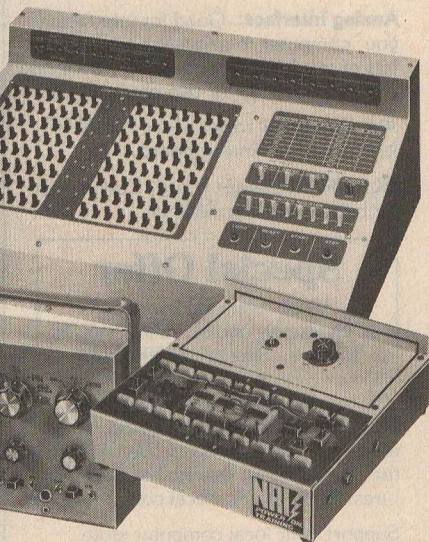
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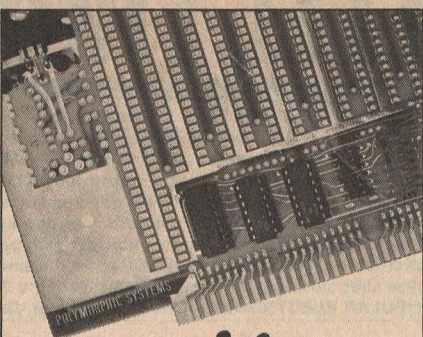
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Poly I/O: With this one you will save a lot of time in making prototype circuits. I/O port address is selectable with dip switch and fully buffered inputs and outputs. \$55 kit.

Analog Interface: Good for interfacing your computer to an analog world. Ten bits of resolution in and out. \$145.00 for one channel and \$195.00 for two channels (kit).

Ask about how to get a free POLY I/O or ANALOG Board.

Watch for our new products. Next time they will be on the shelf before we advertise.

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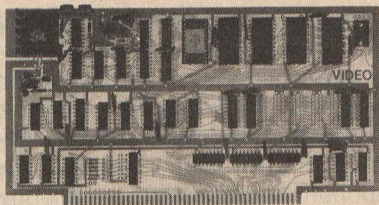
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VIDEO TERMINAL INTERFACE

Connects to standard TV monitor (or modified receiver) to display 16 lines of 64 or 32 characters in a 7 x 9 matrix. Character set includes 128 upper and lower case ASCII characters and 64 graphic characters for plotting 48 x 64 (128 with memory option) array. Text and graphics may be mixed on the same screen. 8-bit keyboard input port is provided. Characters are stored in the on-board memory and may be read or written by the computer. Cursor control, text editing and graphics software is included. Fully compatible with Altair and IMSAI. Sockets included.

VTI/32	32 character line	\$185.00 kit	
VTI/64	64 character line	\$210.00 kit	\$285.00 assd.

ANALOG INTERFACE

Complete interface for a CRT graphics display or X-Y plotter. Provides 8 channels of software-controlled A/D conversion. 1 or 2 channels of analog output with 10-bit resolution (0-10v or $\pm 5v$ out), 6 bits of latched digital output, and 8 analog comparators. Software included for A/D conversion by successive approximation and tracking. Sockets included.

ADA/1	1 analog output	\$145.00 kit	
ADA/2	2 analog outputs	\$195.00 kit	\$255.00 assd.

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low) and a 10% (silver) tolerance. That is, it is a $100,000\text{-ohm} \pm 10\%$ resistor. A 1000-ohm resistor with a 10% tolerance will actually have a resistance somewhere between 900 and 1100 ohms.

Power. Power, in watts, tells us how much heat a resistor can safely dissipate with unrestricted air circulation over normal temperature variations specified by the manufacturer. Exceeding this will either destroy the component or cause it to permanently

COLOR CODE

The ohmic value of a resistor can be determined by means of the color code. There are two standard methods of indicating this value.

In Fig. A, the body (A) and end (B) indicate the first and second digits of the value while the dot (C) indicates the multiplier to be used. The tolerance of the unit is indicated by the end color (D). For example, if the body (A) is green the number is 5; if the end (B) is grey the second number is 8. If the dot (C) is red the multiplier is 100 or two zeros should be added. The resistor is then a 5800 ohm unit. If the end (D) has no color, the tolerance is $\pm 20\%$.

In Fig. B, the first two stripes indicate the first two digits; the third stripe the multiplier; the fourth stripe the tolerance. Thus, if stripe (A) is green, (B) is grey, (C) is red, and (D) is silver, the resistor is a 5800 ohm, $\pm 10\%$ unit.

PE JULY 76

ALTAIR 8800 VIDEO TERMINAL

Video Interface. Plugs into the Altair or IMSAI 8800 bus and connects to standard TV monitor (or modified receiver). 8-bit input connects to almost any keyboard. Characters are displayed as 16 lines of 64 or 32 characters each, in a 7x9 dot matrix. (64 character line requires a high resolution monitor or extensively modified receiver.) The character set includes 128 upper and lower case ASCII characters and 64 graphics characters for plotting a 48x128 (or 64) grid. Characters are stored in the onboard memory and may be accessed directly by the computer. The output is standard 525 line EIA RS170 video.

\$160 Kit \$230 Assem. and tested (Add \$25 for 64 character option) delivery 30 days

Analog Interface. This board is a complete interface for a CRT graphics display or an X-Y plotter, and provides 8 channels of software-controlled A/D conversion. There are 1 or 2 channels of analog output with 10-bits resolution (0-10v or $\pm 5v$ out), 6-bits of latched digital output, and 8 analog comparators.

1 channel (0-10v): \$135 Kit \$175 Assem. and tested

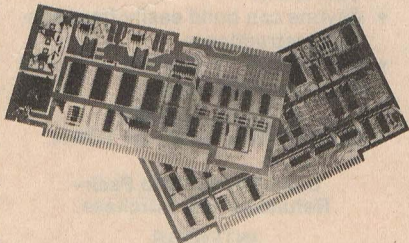
2 channels (0-10v): \$185 Kit \$235 Assem. and tested

(Bipolar option ($\pm 5v$) add \$8 for 1 ch., \$12 for 2) delivery 30 days

Micro Computer. A one board computer system containing an 8080 processor, 512 bytes RAM, space for 1-3K bytes PROM or ROM, and a serial I/O port (optional). Compatible with IMSAI and Altair memory and peripherals. Supports multiprocessing. (Avail. 1st Q. 1976)

Microcomputer System. A system based on our microcomputer and video boards. Includes motherboard, cabinet, power supply, and an operating system and monitor on PROM. (Avail. 1st Q. 1976)

All prices and specifications subject to change without notice. Prices are USA only - Calif. res. add 6% sales tax.



POLYMORPHIC SYSTEMS

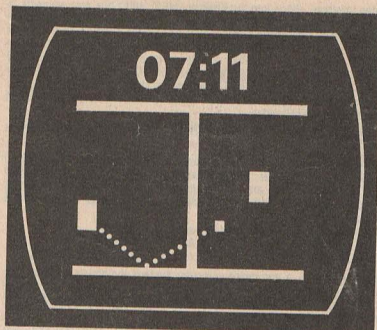
P.O. Box 2207, Goleta, California 93018

CIRCLE NO. 44 ON FREE INFORMATION CARD

A Major Ad

VIDEO PING PONG KITS

Tennis/Handball
with on-screen scoring



- Complete kit supplied, or any combination of plans, parts, PC board, etc.
- Anyone can build easily from concise instructions
- Attaches to TV antenna — no TV alterations required

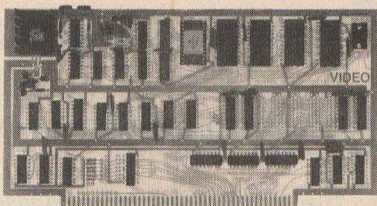
**IT'S THE HOTTEST
ELECTRONIC GAME IN TOWN.**

**Send 50¢ for Info Pack—
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CIRCLE NO. 58 ON FREE INFORMATION CARD

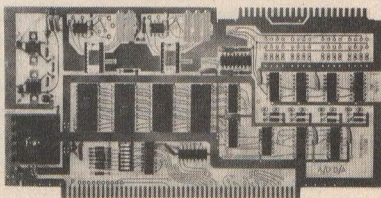
VIDEO TERMINAL FOR YOUR ALTAIR OR IMSAI



VIDEO TERMINAL INTERFACE

Connects to standard TV monitor (or modified receiver) to display 16 lines of 64 or 32 characters in a 7 x 9 matrix. Character set includes 128 upper and lower case ASCII characters and 64 graphic characters for plotting 48 x 64 (128 with memory option) array. Text and graphics may be mixed on the same screen. 8-bit keyboard input port is provided. Characters are stored in the on-board memory and may be read or written by the computer. Cursor control, text editing and graphics software is included. Fully compatible with Altair and IMSAI. Sockets included.

VTI/32 32 character line \$185.00 kit
VTI/64 64 character line \$210.00 kit \$285.00 assd.



ANALOG INTERFACE

Complete interface for a CRT graphics display or X-Y plotter. Provides 8 channels of software-controlled A/D conversion. 1 or 2 channels of analog output with 10-bit resolution (0-10v or $\pm 5v$ out). 6 bits of latched digital output, and 8 analog comparators. Software included for A/D conversion by successive approximation and tracking. Sockets included.

ADA/1 1 analog output \$145.00 kit
ADA/2 2 analog outputs \$195.00 kit \$255.00 assd.

SEE THESE AND OTHER PRODUCTS AT THE FOLLOWING COMPUTER STORES

THE COMPUTER STORE	(213) 478-3168
Los Angeles, CA	
THE COMPUTER MART	(714) 633-1222
Orange, CA	
COMPUTERS & STUFF	(415) 278-4720
San Lorenzo, CA	
COMPUTERS & STUFF	(801) 377-1717
Provo, Utah	
COMPUTER SYSTEMS CENTER	(404) 231-1691
Atlanta, GA	
BYTE SHOP	(415) 969-5464
Mountain View, CA	

DEALER INQUIRIES INVITED

All prices and specifications subject to change without notice. Prices are USA only. Calif. residents add 6% sales tax. Add 5% shipping, handling, and insurance.

POLYMORPHIC SYSTEMS

737 S. Kellogg, Goleta, CA 93017 [805] 967-2351

BankAmericard and Master Charge Accepted

	Low Filter			High Filter	
	R21	R24	R25 *	R22	R23
2125-2975 Hz 1100 Baud	6.8 k	68 k	938	4.7 k	47 k
1200-2400 Hz 300 Baud (Simple)	6.8 k	68 k	4173	4.7 k	47 k
1200-2400 Hz 300 Baud (Correct)	12 k	120 k	1668	5.6 k	56 k
2125-2295 100 Baud (Simple)	6.8 k	68 k	938	4.7 k	47 k
2125-2295 100 Baud (Correct)	36 k	360 k	156	27 k	270 k

* means that the value so indicated is the typical calculated value with tolerance.

Table 1: Theoretical values of components for alternate components to be used with the circuits of figures 1 and 2. This table works with several alternate specifications. See the text on the left of the table.

Potential Troubles

Knowing about potential problem areas is the first step to minimization of their effects. Troubles seem to break down into six classes.

- **Cassette recorders and the cassettes used:** My marriage between your \$1000 microprocessor and a junior's \$20 cassette recorder, which has been using 30¢ cassettes for the last five years, will now produce happy offspring! I have been using Superscope C-104 for the past year, and can report no failures except for defective cassette tapes. The C-104 has several attractive features. Besides the usual conveniences such as index counter, cue, etc., it has a variable readback speed control, and can play out of spec cassettes from friends. Inside, another special motor speed control potentiometer is located near the speaker which allows precise setting of the record/write speed. Quality control seems good overall, and the list price of \$1 (cheaper at discount stores) is worth the investment. Don't waste your money on cheap cassettes. Sony Low Noise C-45s have been generally good. Some \$2 — \$4 Data Certified Cassettes are superior, but not needed.

- **Microprocessor caused problems:** Some microprocessor designs will not work directly with this interface system. This interface was designed to be connected directly to a single bit IO port with the processor handling all of the bit timing through timing loops. If your processor must periodically catch its breath for such things as dynamic memory refreshing, you may be unable to directly use the "Software UART" system. What a shame! However, a hardware UART will permit using the system even with a system of this nature.

- **Cabling problems:** It is possible to connect your cassette recorders with the read and write cables reversed. Enough crosstalk from the write line to the read limiter existed to give the appearance of data being read, but so many errors resulted that the programming would not run.

- **Tuning problems:** Circuit tuning is the most common problem. *Carefully* tune the active filter.

- **Cassette Crashes:** Cassette damage is frequent.

BYTE
JULY 76

Introducing The MICRO-ALTAIR



The complete Computer System that requires just a keyboard and TV monitor for use.

The MICRO-ALTAIR is:

The hardware — video terminal interface board, CPU/ROM/ RAM board, backplane, power supply and cabinet;

The software — video driver, debugger, operating kernel supplied on ROM;

The personal computer system — complete, expandable, no loose ends — a complete and powerful tool;

THE SOLUTION BOX FROM POLYMORPHIC SYSTEMS.

Applications include smart terminals, data acquisition systems, games, accounting, front-end for a larger computer-anywhere a little processing is required.

COMPLETE SYSTEM [EXCEPT FOR MONITOR AND ASCII KEYBOARD] \$575.00 KIT. DELIVERY 60 DAYS — SERIAL I/O AND CASSETTE OPTIONS AVAILABLE.



Go to your local computer store and compare

Video Terminal Interface — characters are stored in on-board memory. Entire screen may be read or written in 20 milliseconds. Software includes a text editing system with scrolling and insert and delete by character or line.

VTI/32	32 character line	\$160.00 kit	\$230.00 assembled
VTI/64	64 character line	\$185.00 kit	\$260.00 assembled
VTI/SK	Socket kit for VTI kit	\$ 15.00	

Delivery — 30 days

Analog Interface — 1 or 2 channels of analog output with 10 bits of resolutions [0-10V or $\pm 5V$ with bipolar option], 6 bits of latched digital output and 8 analog comparators for software controlled A/D conversions.

ADA/1	1 analog output	\$135.00 kit	\$175.00 assembled
ADA/2	2 analog outputs	\$185.00 kit	\$235.00 assembled
ADA/SK	Socket kit for ADA kit	\$ 10.00	

Delivery — 30 days

All prices and specifications subject to change without notice. Prices are USA only. Calif. residents add 6% sales tax. Add 5% shipping, handling, and insurance.

POLYMORPHIC SYSTEMS

737 S. Kellogg, Goleta, CA 93017

(805) 967-2351

BankAmericard and Master Charge Accepted

Avanti's CB mobile antennas

offer:

- Quality construction
- Long range
- Mounting versatility

This is the Avanti Racer 27 mobile antenna. A first quality instrument, it is one of the most popular antennas in the entire CB field. That's because experienced CBers appreciate the benefits of a good, dependable long-range antenna that offers quiet performance.

The Racer 27 is readily adaptable to a wide variety of mounting assemblies:

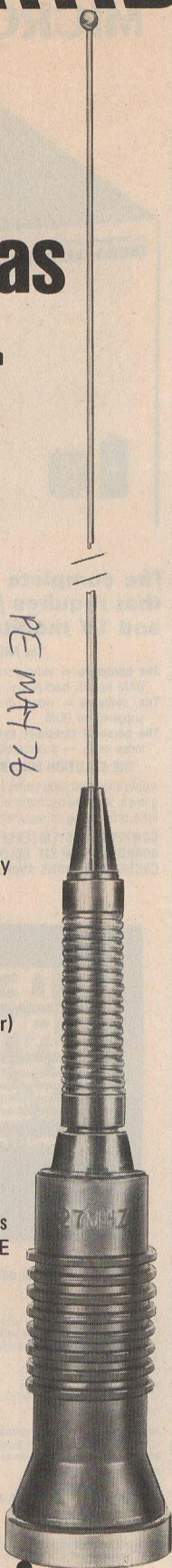
- a fold-over mount for campers and vans
- a no-hole trunk mount (no drilling into your car)
- a mirror bracket mount for trucks
- a dual assembly for increased performance on all vehicles
- Avanti makes the famous MOONRAKER CB BASE ANTENNA

The Racer 27 is Avanti Model AV-327. Suggested retail \$23.95

This is only one of many Avanti antennas for car, boat or home. Send to-day for FREE full-color catalog.

Avanti

RESEARCH AND DEVELOPMENT, INC.
340 Stewart Ave., Addison, Illinois 60101



PE MAY 76

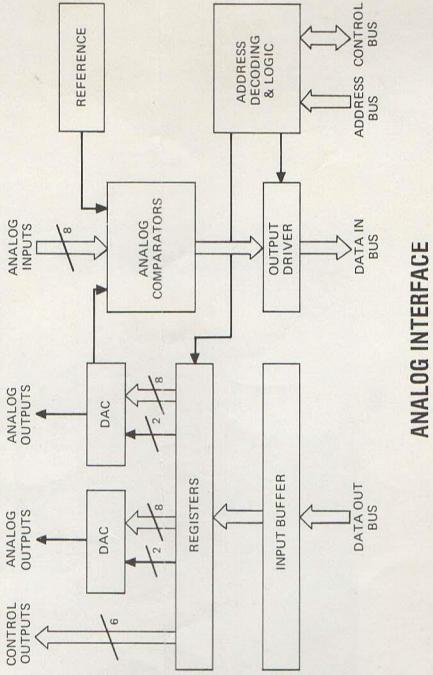
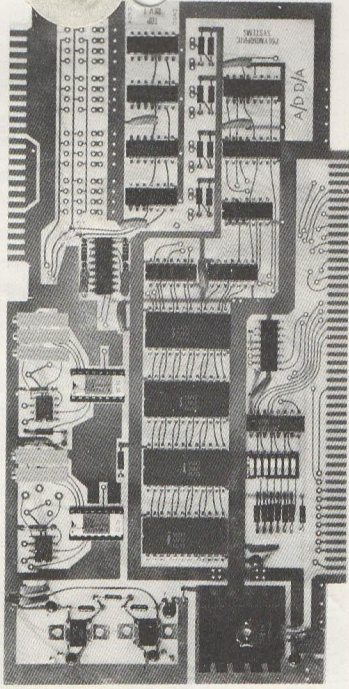
Altair compatible Analog Interface from Polymorphic Systems

Complete interface for a CRT graphics display or X-Y plotter. Provides 8 channels of software-controlled A/D conversion. 1 or 2 channels of analog output with 10-bit resolution (0-10v or $\pm 5v$ out), 6-bits of latched digital output, and 8 analog comparators. Software included for A/D conversion by successive approximation and tracking.

Specifications

D/A section — resolution: 10 bits
Linearity: 0.20% max.
Full scale: 10.0V or $\pm 5V$
Code: Offset binary
Slew rate: 10V/ μ S min.
Output impedance: 75 Ω at 20 KHz
Comparators — number of channels: 8
Voltage offset: 10 mV max.
Voltage range: $\pm 10V$
A/D section — method: Software controlled (drivers incl. for tracking and successive approx. conversion)
Resolution: 10 bits
Full scale: 0-10V or $\pm 5V$

Conversion time: Successive approx. 350 μ S max., tracking 50 μ S max. per channel
Storage temperature: -25 to +85°C
Operating temperature: 5-60°C
Humidity: 0-95% non-condensing
Power requirements: +7 to 9V at 600mA, +15 to 18V at 80mA, -15 to -18V at 50mA
Bus pinout: Plug compatible with Altair 8800 bus
Edge contacts: Gold plated, 100 pin (dual 50) on .125 centers
Dimensions: 5.0" x 10.0" (12.8cm x 25.4cm)



PRICES*

The POLY-88 System

ITEM/DESCRIPTION	KIT	ASSEMBLED	DELIVERY
CP/5 Cabinet, backplane, and power supply	\$155.00	\$225.00	60 days
DPU/8 Processor board (includes RAM, real time clock and vectored interrupt)	195.00	275.00	60 days
VTI/32 Video terminal interface (with 8-bit input port)	160.00	230.00	30 days
ROM/1 Operating system on ROM	125.00	125.00	60 days
2 PC100 100 pin connectors	20.00	20.00	30 days
The complete system purchased separately	\$655.00	\$875.00	
SYS-1 Complete System	\$575.00	\$795.00	60 days
SIO/1 Serial I/O option	75.00	105.00	60 days
CAS/1 Cassette option	90.00	125.00	60 days
DPU/SK Socket kit for DPU/8	10.00		60 days

Other Altair compatible products

ITEM/DESCRIPTION	KIT	ASSEMBLED	DELIVERY
VTI/32 Video terminal interface (32 character option)	\$160.00	185	30 days
VTI/64 Video terminal interface (64 character option)	185.00	255.00	30 days
VDI/M 64 character option for VDI/32	25.00	210	30 days
ADA/1 Analog interface (1 channel)	135.00	145	30 days
ADA/2 Analog interface (2 channels)	185.00	235.00	30 days
ADA/1B Analog interface (1 channel bipolar)	145.00	255	30 days
ADA/2B Analog interface (2 channel bipolar)	195.00	245.00	30 days
VTI/SK Socket kit for both VTI/32 or VTI/64	15.00		30 days
ADA/SK Socket kit for Analog Interface	10.00		30 days

*prices effective until July 1, 1976

All prices and specifications subject to change without notice. Prices are U.S.A. only. Add 5% shipping, handling and insurance. California residents please add 6% sales tax. BANKAMERICARD and MASTER CHARGE ACCEPTED



INTRODUCING
The POLY-88
(FORMERLY MICRO-ALTair)

A complete Computer
System for the
Micro-Computer User.

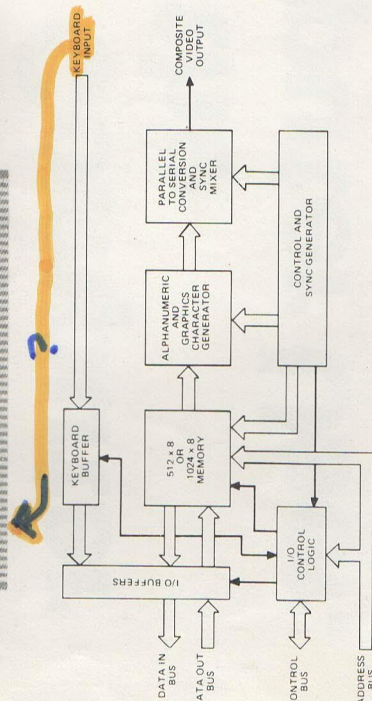
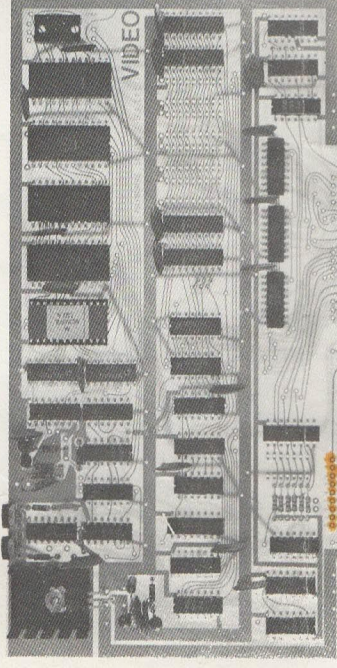
POLYMORPHIC SYSTEMS

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fake video above because of "V"
Video Terminal Interface in video

Connects to standard TV monitor (or modified receiver) to display 16 lines of 64 or 32 characters in a 7 x 9 matrix. Character set includes 128 upper and lower case ASCII characters and 64 graphic characters for plotting 48 x 64 (128 with memory option) array. Text and graphics may be mixed on the same screen. 8-bit keyboard input port is provided. Characters are stored in the onboard memory and may be read or written by the computer. Cursor control, text editing and graphics software is included. Fully Altair and IMSAI 8800 compatible.



VIDEO TERMINAL INTERFACE

Specifications

Cabinet, Backplane & Power Supply

Compatibility: Backplane accepts IMSAI/Altair 8800 peripheral and memory cards
Front panel controls: On/off power switch, reset pushbutton, halt acknowledge indicator and power indicator
Power supplies: +8V at 6A, +18V at 0.75A, -18V at 0.25A (unregulated)
Expansion capabilities: 100 edge contacts (gold plated) on backplane, to mate with 100 pin edge connector mounted on next backplane
Number of card positions: 5
Connector type: Dual 50 pin, 0.125" centers
Cabinet dimensions: 4 1/4" W x 6 3/4" H x 17" D

Processor Board

Processor type: 8080A
Number of instructions: 72
CPU registers: Accumulator, 6 general purpose registers, and stack pointer
Addressing modes: Direct, immediate, register, register indirect
Instruction cycle time: 2-18 microsec.
Interrupts: 8 level vectored interrupt
DMA: Daisy-chained bus request logic allows multiple DMA or processor cards
On board read/write memory: 512 bytes, 500 ns access time
Read only memory: Sockets provided for 3K bytes ROM or EPROM (2704 or 2708 EPROM)
Serial I/O rates: 50-56K baud synchronous or asynchronous
Serial I/O levels: Selectable, RS-232C, 20mA current loop or audio cassette interface
Cassette interface: 1200Hz mark, 2400Hz space at 300 baud, 2400Hz mark, 4800Hz space at 600 baud (Kansas City standard interface)
Bus interface: compatible with Altair and MICRO-ALTAIR™ products 16 bit address bus, 8 bit data input bus, 8 bit data output bus and control bus
Bus loading: Outputs drive 30 TTL loads, input are 1 TTL load or less
Bus pinout: Plug compatible with Altair 8800 bus.
Edge contacts: Gold plated, 100 pin (dual 50) on .125" centers.
Dimensions: 5.3" x 10.0" (13.46cm x 25.4cm)
Serial I/O option

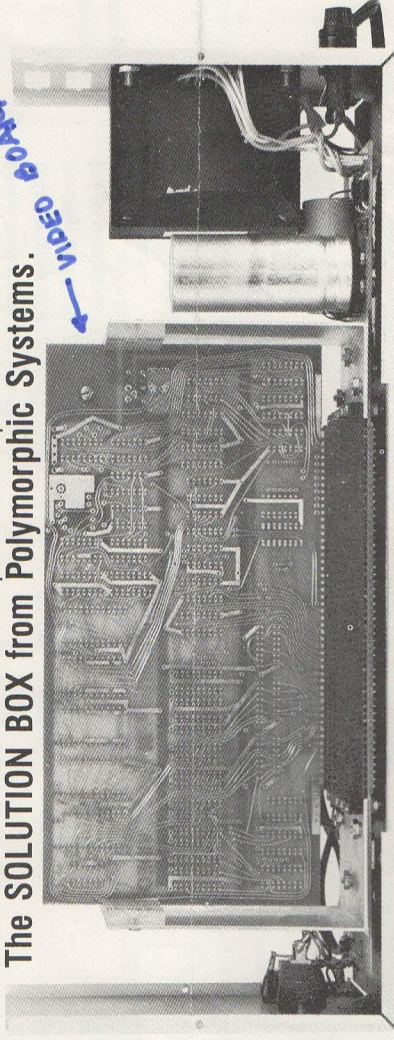
Video Terminal Interface

Character font: 7 x 9 dot matrix alphanumeric and 6 element graphic characters completely filling character location
Code: ASCII-7 with 8th bit enabling graphic characters set
Character set: 192 — including upper and lower case alphanumeric and 64 graphic characters.
Number of characters: 512 (1024 optional) 32 (64) characters per line with 16 lines
Graphic resolution: 64 (128) horizontal elements by 48 vertical elements
Video output: Composite video, negative sync.
Required bandwidth: 2.5 MHz for 512 characters (standard TV set or monitor) 5.5 MHz for 1024 characters (high-resolution monitor)
Input port: 8-bits, positive or negative strobe.
Bus pinout: Plug compatible with Altair 8800 bus.
Edge contacts: Gold plated, 100 pin (dual 50) on .125" centers
Dimensions: 5.3" x 10.0" (13.46cm x 25.4cm)
Storage temperature: -25 to +85°C.
Operating temperature: 5 to 60°C
Humidity: 0-95% non-condensing
Power requirements: +8 to 10V at 1.2A typ., +15 to 22V at 30mA, -15 to 22V at 20mA

POLY-88 — The complete Computer System that requires just a keyboard and TV monitor for use.

The POLY-88 is:

- The hardware — video terminal interface board, CPU/ROM/RAM board, backplane, power supply, and cabinet;
- The software — video driver, debugger, operating kernel supplied on ROM;
- The personal computer system — complete, expandable, no loose ends — a complete and powerful tool;
- The SOLUTION BOX from Polymorphic Systems.



Cabinet, Backplane & Power Supply

The POLY-88 cabinet is a quarter-rack chassis containing a backplane and a heavy duty power supply. The backplane design is unique in that many backplanes can be plugged together for easy system expansion. Each has a 100 edge contacts and space for 100-pin edge connector to mate with the next backplane assembly. This allows for several cabinets to be plugged together, providing extra space and power for as many cards as desired. Alternatively, a circuit card can be plugged into this expansion slot without opening the cabinet, eliminating the need for an extender card for circuit debugging. Each backplane contains its own power supply (transformer mounted to chassis) rated at 8 volts at 6 amps, +18 volts at 0.75 amp and -18 volts at 0.25 amp. Five boards may be mounted in each backplane assembly.

Processor Board

The POLY-88 is based on the powerful 8080A microprocessor chip, which executes a set of 78 instructions for manipulating 8 and 16 bit data. The processor utilizes 4 addressing modes — direct, register, register indirect and immediate — capable of addressing 64K bytes of memory, and 512 input/output ports. Contained on the board are 512 bytes of read/write memory and space for 3K bytes of read-only memory with under 500 ns access time. An option on the processor board is a serial I/O port. Synchronous or asynchronous data may be transmitted at rates up to 56,000 bits per second, configured as an RS-232C or a 20 MA current-loop interface. Space for an optional modem (modulator-demodulator) is provided for an audio cassette interface using the Kansas City standard format.

The processor board plugs directly into the POLY-88 or IMSAI/Altair 8800 bus. When used with the POLY-88 backplane, additional processor boards may be plugged in for microprocessing as the necessary logic is included on the board. Memory and I/O ports added to the backplane are common to all processors while onboard memory and I/O are private to each processor. Each processor board supports up to 8 hardware priority interrupts with more levels available in software. A real-time clock is available, synchronized to the 50 or 60 Hertz line frequency.



Software

The ROM included on the CPU board contains the resident operating system for the POLY-88 computer. Implemented in this ROM are a versatile set of "front-panel" functions, debugging aids, and device drivers for keyboard and video display, cassette tape, and ASCII terminals. The front panel functions allow the display and entry of memory data and CPU registers in varied formats, including ASCII octal and hexadecimal. Programs may be halted, restarted, or breakpoints may be inserted from the keyboard. The device drivers, which are also accessible from user programs, provide for control of the video display, keyboard, ASCII terminal, and the reading and writing of data onto magnetic tape using the optional audio cassette interface. Since keyboard, display, and magnetic tape I/O are controlled using the vectored interrupt system, I/O actions may be concurrent with processing.

Computer and Integral Disk Operating System

PolyMorphic System 8813. A complete system — keyboard, video monitor and microcomputer with a built-in smart floppy disk drive and provisions for two optional drive units.

The 8080A processor has an 8-level interrupt system, instruction length of 8, 16 and 24 bits and a cycle time of 2-9 μ s. 65,536 byte memory addressing capability. Memory includes 16,896 bytes RAM and 3,072 bytes ROM—access time; 500ns.

Video terminal interface features 16 lines of 64 characters each and includes 96 ASCII and 32 special symbols. 7x9 dot matrix character font with a graphics resolution of 128 horizontal; 48 vertical. 70,000 characters per second update speed.

Disk drive unit transfer rate is 125,000 bits/sec. with a latency of 100ms. 35 tracks per disk, 10 sectors per track with a track-to-track access time of 40ms. 89,600 data bytes per disk with a hard error rate of less than 1 in 10¹¹ bits read. Software includes BASIC interpreter, easy-to-use text editor, assembler and other system utilities.

105-130VAC, 50-60Hz power supply, fan, ten S-100 card slots and walnut-look cover. Keylock power switch. With full instructions. 8x20x17 $\frac{3}{4}$ ".

81-1401. Shpg. wt. 60 lbs. **3250.00**

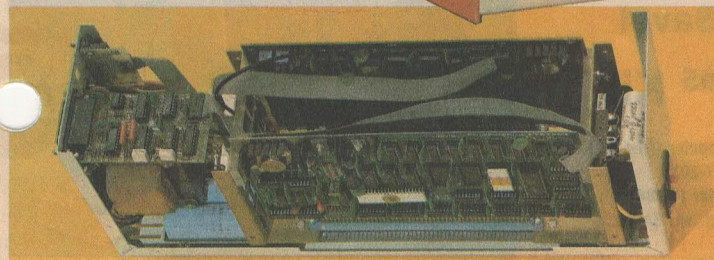
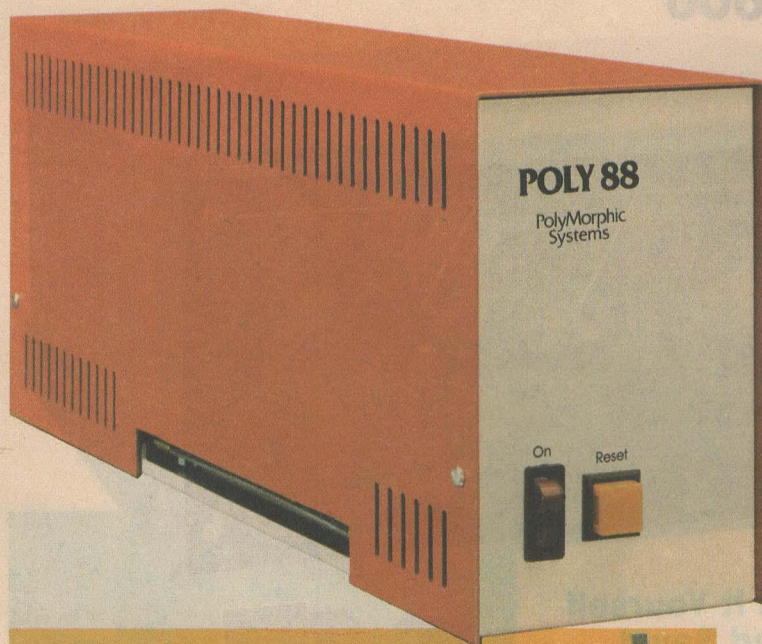
Additional Shugart Disk Drive Unit. Add up to two more for advanced capabilities.

84-909. Shpg. wt. 4 lbs. **Each 590.00**

Software Specifications (11K BASIC): Read and Write Disk Files from BASIC; Input type-ahead; Cassette Save, Load, and Verify of Named Programs; Multi-line Functions; Point-Plotting on Video Display; Real-Time Clock; String Manipulation and String Functions; Formatted Output; Memory Load and Store; 8080 Input and Output; Multiple Statements per Line; Renumber; If Then Else; Array Dimensions limited by Memory; Single Character Input. **Commands:** RUN, LIST, SCR, CLEAR, REN, CONT, SAVE, LOAD, VERIFY. **Statements:** LET, IF, THEN, ELSE, FOR, NEXT, GOTO, ON, EXIT, STOP, END, REM, READ, DATA, RESTORE, INPUT, GOSUB, RETURN, PRINT, OUT, POKE, PLOT. **Built-in Functions:** FREE, ABS, SGN, INT, LEN, CHR\$, VAL, STR\$, ASC, SIN, COS, LOG, TIME, EXP, CALL, SORT, PEEK, INP. **Scientific Functions:** Sine wave, log, exponential, square root, random number, x to the y power.



Shown with two optional disk drives



The Compact Microcomputer from PolyMorphic Systems

- Buy the Complete Package or Just the Circuit Boards
- Assembled or in Kit Form for "Do It Yourselfers"

POLY 88-2. Beginners will appreciate the modest price and being able to choose between assembled or kit form. Experienced users will like the POLY 88 kit because it's compact enough to be a portable yet powerful enough for sophisticated operations.

Packed into the space-saving 6 $\frac{3}{4}$ x4 $\frac{1}{4}$ x17" cabinet is an S-100 compatible microcomputer that lets your system grow as your budget grows.

The 8080A-based CPU board has a resident real time clock and vectored interrupt. And there's 1 $\frac{1}{2}$ K of RAM and 1K monitor on ROM with provisions for an additional 2K of ROM. The video terminal interface board displays 16 lines of 32 characters on a home tv screen and is expandable to 64 characters. Limited graphics (48 by 128 grid) are useful for video games and other applications.

The POLY 88 ROM monitor is used to display data on a tv screen, enter data into memory keyboard and read and store data on audio cassette tape. It also allows for single-stepping through a program while displaying the contents of the 8080A internal computation registers.

Front panel controls include on-off power switch, reset button, halt acknowledge indicator and power indicator. Handles up to 5 cards per chassis and is expandable for more chassis with optional edge connector socket.

Includes cabinet, power supply, CPU, video circuit card, cassette interface and complete assembly and operation instructions.

81-1303. Kit Form. Shpg. wt. 21 lbs. **735.00**

81-6303. Factory Assembled. Shpg. wt. 21 lbs. **935.00**

POLY 88-0. The circuit cards an S-100 mainframe owner needs to be compatible with the POLY 88 software library. Consists of the central processor card with monitor ROM, the video circuit card and cassette interface.

81-1302. Kit Form. Shpg. wt. 10 lbs. **595.00**

81-6302. Factory Assembled. Shpg. wt. 10 lbs. **795.00**

Order by Phone — Call Tandy Computers TOLL-FREE at 1-800-433-1679

Low-Cost 6800 Kit Systems

by Southwestern Technical Products



Save 179⁰⁵
Reg. Separate
Items 2979.00
2799⁹⁵
(Assembled)

- SWTPC 6800 Microcomputer w/12K Memory (81-6202)
 - Soroc IQ 120 Terminal (87-202)
 - BFD-68 Floppy Disk System (84-1707)
 - Extra Floppy Disk (84-905)
- Complete System. Shpg. wt. 75 lbs.
Assembled 2799.95



Save 170⁸⁵
Reg. Separate
Items 1370.80
1024⁹⁰

- SWTPC 6800 Microcomputer (81-1202)
 - CT-64 Terminals (87-302)
 - PerCom I/O Cassette (83-1203)
- Complete System. Shpg. wt. 48 lbs.
Kit 1024.90



- 4K of 8-Bit RAM
- Monitor ROM
- TTL Compatible
- DMA Capability
- Documentation Package
- Thorough Assembly Instructions

SWTPC 6800. Designed around Motorola's 6800 microprocessor chip, the 6800 kit is versatile in all applications. The basic system includes the chassis, motherboard, memory card with 4096 bytes of 8-bit RAM, 20mA/RS232 interface, and a power supply capable of driving the system with a full 32K bytes of memory. The Motorola MIKBUG® mini-operating system in ROM enables complete terminal control the instant the system is turned on. No time-consuming switching! In fact, the need for a program console is eliminated. A debug routine is contained in the computer for debugging user programs. All data input and output is in convenient hexadecimal (base 16), a pleasing alternative to confusing binary switching. A thorough documentation package is included with the kit. For 120VAC, 60Hz.

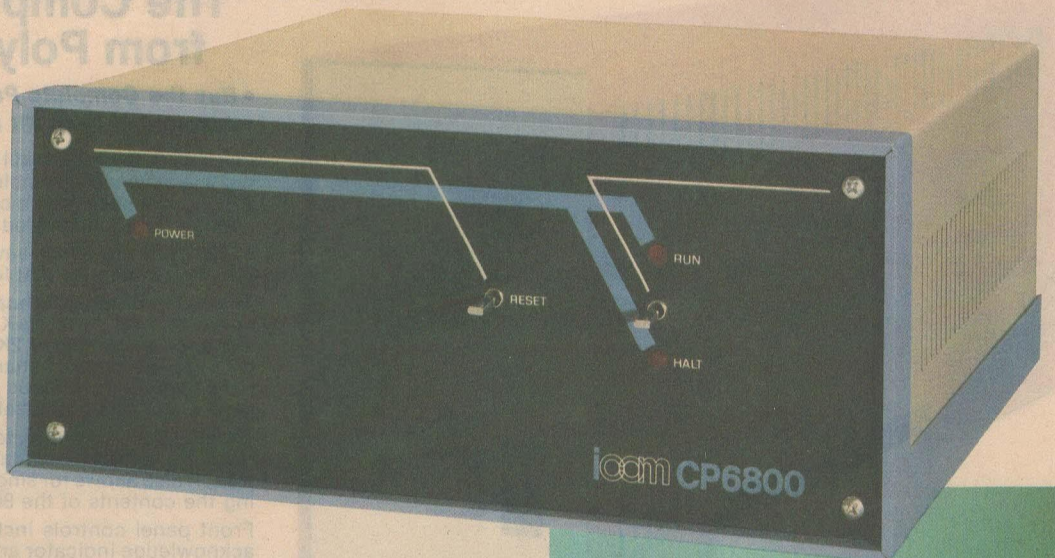
81-1202. Kit. Shpg. wt. 27 lbs. 3
81-6202. Assembled. Shpg. wt. 27 lbs. 4

Value Begins with ICOM 6800

- Load and Run Programs without Entering Bootstraps
- I/O Operation on RS232 or TTY Levels
- ACIA for Interfacing Software to Serial Devices
- 1K RAM • 256-Byte PROM Monitor

ICOM 6800. Extensive computing capabilities at a reasonable price make the ICOM 6800 the perfect choice for home or business use. The system, based on the 6800 microprocessor chip, contains a mainboard with 1K RAM memory, 256-byte PROM monitor, and a 6850 Asynchronous Communication Interface Adapter (ACIA). An extra 1K of PROM can be added. This highly functional system takes very little space, and future expansion is easy because of the simple one-board construction. The PROM monitor allows immediate loading and running of programs in both BASIC and Assembly languages. No hassle with bootstrapping! Software-controlled interfacing to serial terminal devices is made possible by the ACIA. Input/Output operation may be configured for either RS232 or TTY levels. An Expansion Card is also included to facilitate fast and easy expansion. The card plugs into the mainboard, and up to three extra boards may be inserted. Clock frequency of the 6800 is 500KHz, and add time, register to register, is 2 micro-seconds per data word. The 6800 system accommodates 72 instructions. For 120VAC, 60Hz.

81-1201. Shpg. wt. 10 lbs. 395.00



**Build It Yourself
and Save!**

1294⁹⁵ Kit

- ICOM 6800 Microcomputer (81-1201)
 - Informer Terminal (87-203)
 - Cassette Data Recorder (14-841)
- Complete System. Shpg. wt. 34 lbs.
Kit 1294.95

